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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Fifth Annual Meeting, Pacific Coast Gas Association.

PACIFIC COAST GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
OAKLAND, CAL., June 4th, 1897.

The fifth annual meeting of the Pacific Coast Gas Association will be held at San Francisco, Tuesday and Wednesday, July 20th and 21st, 1897, at 10 o'clock, A.M., in the office building of the San Francisco Gas and Electric Company.

A meeting of the Board of Directors will be held on Monday, July 19th, at 8 P.M., at headquarters in same building.

The following papers will be read and discussed during the sessions:

The President's Address, by Mr. T. R. Parker, Napa, Cal.

"Spontaneous Ignition of Coal," by Mr. John L. Howard, San Francisco.

"Reminiscences," by Mr. F. H. Eichbaum, San Francisco.

"Value of Small Gas Bills," by Mr. W. W. Gillespie, San Francisco.

"From Coal Gas to Natural Gas," by Mr. John Kempf, Jr., Salt Lake City, Utah.

"Small Lighting Plants and their Management," by Mr. Thos. D. Petch, Eureka, Cal.

"Practical Suggestions," by Mr. Chas. E. Burrows, Walla Walla, Wash.

"Uniformity of Accounts," by Mr. C. O. G. Miller, San Francisco.

"Municipal Control," by Mr. C. W. Quilty, San Jose.

"A Short History of a Long Life," by Mr. C. M. Converse, San Francisco.

"Recuperative Benches for Coke and Coal Firing," by Mr. D. R. Russell, St. Louis, Mo.

"Card Bookkeeping," by Mr. V. Stow, San Francisco.

"Gas as Fuel," by Mr. F. Foveaux, San Francisco.

Questions received will be assigned to members for reply.

The "Experience" Department, edited by Mr. John Clement, of Red Bluff, Cal., and the "Wrinkle" Department, edited by Mr. M. C. Osborn, of San Diego, Cal., will make report.

All gas men sojourning in San Francisco at the time of the meeting are cordially invited to be present and to participate in discussions. The Secretary will at all times cheerfully answer any questions and furnish information concerning the meeting, hotel accommodations, etc.

Thursday, July 22d, 1897, will be the outing day for members, their families and friends. A trip on the world-famed scenic railway to the top of Mount Tamalpais will be made, and luncheon served at the "Tavern of Tamalpais." From San Francisco to the mountain top there is revealed the grandest panorama of ocean, cities, towns, bays, valleys and mountains in the world, the view reaching from the snow-capped Sierras to 60 miles from the Marin county shores on the Pacific. The usual banquet will be held on Tuesday evening, July 20th.

Eastern members, and others from the Eastern States intending to visit San Francisco, are requested to advise the Secretary in advance.

JOHN A. BRITTON, Secretary.

BRIEFLY TOLD.

DEATH OF MR. GEORGE S. HARRIS.—We regret to report the death of Mr. George S. Harris, for many years Superintendent of the Mansfield (O.) Gas Light Company, who died at Hot Springs, Ark., on the morning of Sunday, June 14th. Deceased, accompanied by his son, Mr. William Harris, journeyed to Hot Springs towards the close of last April, in the hope that a sojourn at the Springs would stay the complaint from which he suffered, but death would not be denied. In the early eighties Mr. Harris was quite prominent in Western gas circles, and was very much interested in Association proceedings, having been a member of the Western Gas Association and of the Ohio Gas Light Association, at the meetings of which he was a frequent attendant. He was born in Washington county, Pa., in 1836, and his earliest business connections seem to have been established in Bucyrus, O., which place he settled, in about 1859. In 1862 he accepted the position of Superintendent to the Mansfield Gas Light Company, which place he filled acceptably for well over a quarter of a century. He was also engaged in other business lines in Mansfield, and at the time of his death was the senior member of the firm of George S. Harris & Sons, whose specialty was trading in the stove and tinware line. Deceased was prominent in the Masonic circles of Ohio, and, besides his membership in the Western and Ohio Associations, was also on the rolls of the National Association of Master Plumbers. His widow, a daughter and two sons (Ralph and William) survive him. The funeral services were held at his late residence in Mansfield, the religious ceremonies being directed by the Rev. F. G. McFarlan, and the Masonic rites were conducted under the auspices of Mansfield Commandery, K. T.

FIELD'S ANALYSIS FOR 1896.—We are indebted to the courtesy of the compiler for a copy of "Field's Analysis of the Accounts of the Principal Gas Undertakings in England, Scotland and Ireland" for the year 1896, which completes the 28th year of the publication of this most useful work. It is not necessary for us here to repeat that which we have had occasion to say about this excellently arranged work of Mr. Field's each time that it comes to hand, so we may pass that part of our reference in the remark that it is just as valuable as ever, which estimate means that it is sufficiently valuable and useful to have a get-at-able place in the library of every one interested in the gas industry, either from the point of an engineer or from the view of an investor in gas shares. We do not propose to repeat the figures which Mr. Field's tables hold, but we will just mention the fact, by way of proof that the gas business of London is in rather a healthy condition, that the three Metropolitan Companies of the world's largest city made and sold the the following quantities of gas in 1896:

Company.	Gas Made, Cu. Ft.	Gas Sold, Cu. Ft.
Gas Light and Coke....	21,465,511,000	20,115,728,000
Commercial.....	2,368,225,000	2,166,255,000
South Metropolitan	8,767,311,000	8,180,187,000

NOTES.—Mr. John F. Meagher, President of the Mankato (Minn.) Gas and Electric Light Company, died at his home in that city on the evening of June 19th. Deceased, who was also President of the National Citizens Bank, of Mankato, was born in Ireland, in 1836, and accompanied his parents to America in 1847, the family settling in Northern Illinois. In 1858 he became a resident of Mankato and became identified with the railroad interests of Minnesota, first as a constructor and afterwards as a financier. In 1870 his fame and fortune were firmly established, and subsequently he became a prominent figure in the Democratic politics of the State, which he served as a legislator and in other capacities. Two sons and three daughters survive him.——Secretary Hand, of the Scranton and Hyde Park (Pa.) Gas and Water Company, has been authorized to publish the following reduced schedule of gas rates, the same to take effect on and after July 1st: Gross, per 1,000 cubic feet, $1.20, with 5 per cent. off for prompt payment (within 20 days), on all accounts showing a consumption per month amounting in value to less than $25, the discount to be increased to 10 per cent., where the monthly consumption exceeds $25.——Mr. J. A. McCollum, Superintendent of the Riverside (Cal.) Gas Company since 1888, has tendered his resignation, the same to go into effect July 1st.——A deal has virtually been consummated whereby certain interests, said to center in New York, have secured control of the stock of the New Haven (Conn.) Gas Light Company, at a price amounting to 280 per cent. As the capital stock of the Company stands at $1,000,000 (par $25 per share), this means an investment by the combination of $2,800,000. The understanding is that the purchasers are the parties who were behind the recent applications for charters for the right to supply gas in New Haven and Hartford, which applications were so summarily rejected by the Connecticut Legislature.——President Holmes, of the Santa Ana (Cal.) Gas and Electric Company, says that the supply of incandescent electric light by that Company, which supply was discontinued about two years ago, will be recommenced by September 1st.

[Prepared for the JOURNAL.]

Locating, Determining and Laying of Street Mains and the Distribution of Gas.—No. IX.

By MR. J. P. GILL.

There are some towns which are built largely on one thoroughfare, with short branch streets leading therefrom, the calculations for which will be based on the method shown in Plates Nos. 10 and 10a. If a side street should require a larger pipe than 3 inches its length may be divided into shorter ones, as in Plates Nos. 3′, etc. Or two neighboring but separate small towns or large villages may be so situated that they can be supplied with gas from a works built at a near and intermediate location. A short, large main can be laid to some point, X, where it can be branched off into two mains. Let the two towns be designated by A and B. Let the distance from the works to X, where the branches commence, be 200 yards, and the length from X to and through A be 1,500 yards, and the consumption, actual and prospective, be 10,000 cubic feet per hour; and let the length from X to and through B be 1,000 yards, and let the consumption in B be 6,000 cubic feet per hour. There will then be, from the works to X, Q = 16,000 cubic feet, L = 1,700 yards, H = 1 inch, and the specific gravity = .5.

$$D^5 = \frac{.0000006 \times .5 \times (16{,}000)^2 \times 1{,}700}{1} = 130{,}560,$$

requiring a 12-inch pipe.

$$f = \frac{.0000006 \times .5 \times (16{,}000)^2 \times 1{,}700}{248{,}832} = .52 \text{ inch.}$$

1.00 — .52 = .48 inch, the pressure at X.

There are, then, for A, Q = 10,000 cu. ft., L = 1,500 yds., H = .48 inch;
and for B, Q = 6,000 " L = 1,000 " H = .48 "
to find the diameters of the pipes, etc.

Again, let the districts be contiguous. The calculations may be made as indicated in Plates 3, 4, 7, 8, 9, 10, according to the circumstances and conditions. Special examples can be worked out as occasion may require.

A town of the size selected for the purpose of this investigation, and laid out in avenues and streets as in the examples employed, would evidently, if fully built up and inhabited, consume more gas than that herein assumed, viz., 60,000 cubic feet per hour. This will not, however, affect the accuracy of the work for the object in view, since any other quantities of gas consumed may be substituted for Q in the equations. Therefore, the exemplification given of the principle and mode of locating mains, and of estimating the diameters of the pipes and the pressures, is applicable to sparsely settled as well as thickly settled towns and cities, whether they be larger or smaller.

The preceding estimates have been made for a city that is comparatively level, as New York, Philadelphia, Boston, etc.; but that for which these estimates are intended has, by hypothesis, a rise of 310 feet in 3 miles, as it recedes from the river.

As gas gains in pressure 1 inch in about 100 feet of elevation, street regulators are required in this case.

When there are three supply pipes running north and south, there will be six regulators in all, each line requiring two.

Taking the supply main running from east to west, that is from A to D parallel to the river, for the base line, commencing at the points B, C, D, and running north, the regulators will be located as follows: Referring to Fig. 12, page 720, which is here shown, enlarged and completed (see Fig. 12a) for further use, it will be seen (designating the two regulators by R and Ra) that there is one 1,095 yards from C′ towards C″, and one 250 yards from C″ towards C‴.

These distances are easily found by simple proportion. The distance from C′ or M to N is 3,500 yards, and the rise above M to N is 240 feet. The rise of R above M is 75 feet.

240 : 75 :: 3,500 : 1,095, the yards from C′ or M to R.

240 : 175 :: 3,500 : 2,550, the yards from M to Ra. From 2,550 deduct 1,095, which will leave 1,455 yards, the distance from R to Ra. From C′ to C″ is 2,300 yards, which deducted from 2,550 yards leaves 250 yards for the distance from C″ to Ra.

To find the pressures on the level below R and Ra is a similar process, the distances and rise of ground being of course the same. The pressure at C′ was found to be .91 inch (see Plate No. 3), that at C″ .66 inch, and that at C‴ .23 inch; the difference between those at C′ and C″ being .25 inch, and between those at C″ and C‴ being .43 inch. Therefore, 2,300 : 1,095 :: .25 : .12, and .91 — .12 = .79 inch, the pressure under R. Again, 2,100 : 250 :: .43 : .05, and .66 — .05 = .61 inch, the pressure on the level under Ra.

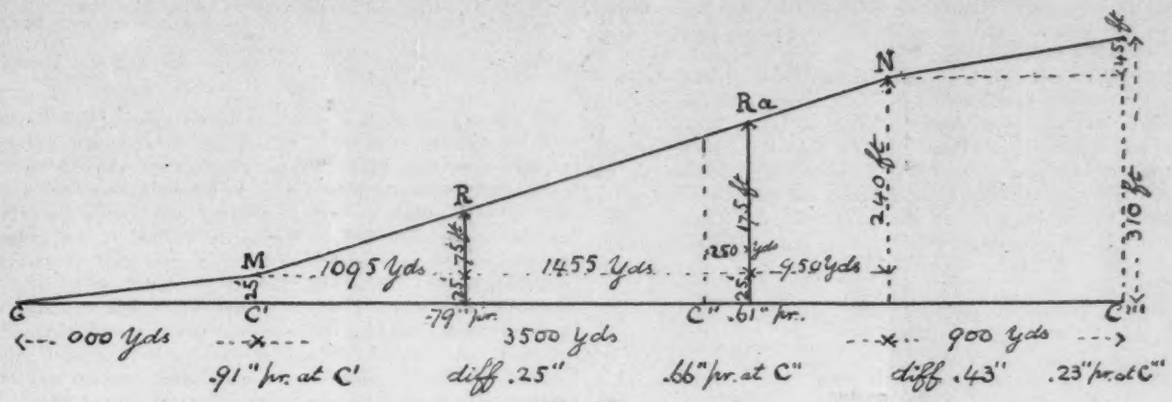

Fig. 12a.

The pressures below *R* and *Ra* on the B and D lines will be found to be .75 inch and .70 inch between B′ and B‴, and .68 inch and .57 inch between D′ and D‴.

It has been taken for granted that the town is practically level, in an easterly and westerly direction, parallel with the river. If not, the points at which the successive 100 feet elevations, as, for instance, between B′ and B‴, can be ascertained by means of the engineers' leveling instrument, and then the distances being measured, the calculations can be made.

Of course, the smaller pipes in the districts cannot be connected together across the imaginary lines running easterly and westerly between the regulators, for if they were the regulators would be of no value.

Referring to the plan in Plate No. 8, which gives average pressures, the mode of calculation will be identical, but the pressures on the level below *R* and *Ra* on the lines parallel with the river will be equal.

It has been shown that a single supply pipe is preferable to two or more, because of the economy in the cost of laying the mains. It is also preferable, because of the saving in the first cost of the regulators, there being in this case 2 instead of 6, and also because of the economy and ease of attending them when in operation, and because of the possible facility with which the pipes north and south of the regulators can be separately laid.

Referring again to Plate No. 7, having one main supply pipe, let it be ascertained what the pressures will be under *R* and *Ra*, all the terms excepting the pressure being the same as before. The pressure at C′ is .87 inch and that at C″ .50 inch, the difference being .37 inch; the pressure at C‴ is. 36 inch, the difference between C″ and C‴ being .14 inch. 2,300 : 1,095 :: .37 : .17 ; .87 — .17 = .70 inch, the pressure below *R*. 2,100 : 250 :: .14 : .02; .50 — .02 = .48 inch, the pressure below *Ra*.

The object of this calculation is not an indifferent one, but is intended in part as a guide for the *regulation* of the regulators. It is apparent that the greater the distance from the holder, the less is the terminal pressure due to the loss of pressure by the passage of the gas through the pipes ; and the diminished pressure corresponds with the fact that a less quantity of gas is to be distributed beyond that point. It is not uncommon to set the pressure at the regulators at the same height as that at the holders, but it is evident that there need not be any greater pressure at the regulators than would be in pipes on the level below them, for the reason that the same quantity of gas is to be passed through the pipes at either elevation. The pressure at the regulators might possibly be less than that on the horizontal line, which decreases as the distance increases, while that above the regulator gradually becomes greater.

If the pressure at the holder is 2 inches, that at the regulator *R* (see Fig. 12a) need not be greater than .79 + 1 = 1.79 inches, and that at *Ra* .61 + 1 = 1.61 inches. This would not only save leakage, but the greater pressure when ascending the hill and on the upper level.

There has not yet been any estimate made of the cost of the district pipes running north and south, and connecting with those running east and west, at the intersections of the streets. This was omitted at the time when the comparison of costs was made, because these pipes are required to supply only one block consecutively, and would consequently be the same in all the systems illustrated.

The estimate is made with the following and similar data. Take district No. (6), for instance, in which there are eight streets running in one direction and 20 in the other, making, say, 120 lengths of pipe, each length equal to that of one block, viz , 288 yards. The total consumption being 12,000 cubic feet, the consumption in each length of 288 yards would be 75 cubic feet per hour, and with any pressure, as of .10 inch or upwards. These data will show that 3-inch pipes are of an amply large dimension.

What Buyers of Spent Oxide Want.

According to the *Gas World*, in an address to the Mid-Rhine Gas Association, from the point of view of purchasers of spent oxide, etc., Dr. Auerbach said that gas purifying material, when spent and sold, varies in the most extraordinary way, from one works to another; the water varies from 2 to 40, the sulphur from 10 to 55, the sulphocyanides from 0 to 16, the ammonia from 0 to 8, and the Prussian blue from 0 to 15 per cent.; the colors vary from yellow to black, with all shades of blue; some are dry powders, some are soft wet masses, and some are half sawdust and chips; and the money value of the spent material varies accordingly. The Cologne works make $10,000 a year from the spent purifying material by methods which are within the reach of all, the product being rich in Prussian blue.

It would not be worth while to select the coal or the mode of distillation with a view to the production of cyanogen, for other considerations are of more importance; but dryness of the gas is of importance, since too damp a gas clogs the purifying material ; and this points to proper cooling of the gas during condensation, so as to get the moisture out of it. Tar particles in the gas, if they reach the purifiers, have a very bad effect on the quality of the spent material ; they clog it up and compel its premature renewal, and they make it difficult to lixiviate, so that the Prussian blue makers would rather not have it. The greatest foe to the production of Prussian blue in the purifiers is the presence of ammonia, which makes sulphureted hydrogen and hydrocyanic acid coalesce to form sulphocyanides; as also do other free alkalies. And besides, another result is that the mass rapidly becomes impermeable and sludgy. Therefore, ammonia should be kept out of the purifiers. As to the purifying mass, in France, Spain, Italy and the East great use is made of Laming's mass, which consists of sawdust mixed with lime and wetted with a solution of sulphate of iron. The proportion of useful material in this is too small, and the excess of lime is partly inert and partly detrimental, in respect that it encourages the formation of sulphocyanides instead or ferrocyanides; and, in fact, it hardly pays to recover the sulphur from the residues.

Other purifying materials consist of iron oxide (mostly a residue from the treatment of bauxite), along with an excess of soda. The iron oxide is very finely divided, but the alkali does harm, and the material needs a support such as sawdust, which causes a reduction in the percentage values at the end of the process. Besides, sawdust absorbs a lot of water and actually sometimes makes the mass quite wet, up to 38 per cent. water. All the artificial preparations fall behind the natural "meadow ore" or "bog ore," in some of its forms. This form of iron ore varies very much, even according to the way it has been dug and stored ; but a good sample is fragile and soft, free from hard lumps, and, on the other hand, it is not so fine in the grain as to lie compact, but remains spongy and porous, the pores amounting to about three-quarters the whole volume. Such ores are, of course, very light, and produce little pressure in the purifiers. The hydrated iron oxide is the only useful component ; but it does not follow that the best purifying ore is the one which contains the highest percentage of this. In

England the competition seems to be between the percentages of iron oxide in the various bog ores; and the consequence is that the ore finally selected is rich in oxide, but is very dry, hard, and feebly absorptive, so that the English works have not earned any laurels in respect of their results in this connection. It must not be forgotten that the oxide of iron must be thoroughly hydrated before it will take up sulphur and cyanogen, and that the oxides richest in iron are usually the worst in this respect; that it must be porous so as to allow the gas to go through without needing any support, and this is secured by the grass roots, etc., which penetrate the mass and split it into a porous condition. If the percentage of oxide is only reduced by organic matter and water (which latter may stand as high as 40 per cent. or more) there is no harm done; but it is otherwise if there be much sand or clay, which are sometimes present in such quantity as to make a good looking sample comparatively useless.

With regard to the use of the purifying material, the ordinary mistake is to have the purifiers too small. The speed of the gas should never exceed ½ inch per second. Small purifiers lead to thick layers, and those to clogging. The temperature of the purifiers should be watched. The revivification requires great care; and the days of dumping the oxide in a heap are passed. The mass ought not to be allowed to heap up. It is not in the least necessary to make a heap in the first place; the spent material should be at once spread in layers from 8 to 12 inches thick, but no more. In these layers furrows should be made. If the mass gets too warm the iron oxide is dehydrated and the cyanogen compounds are charred, so that sulphide of ammonium is formed from them; and the amount of sulphide of ammonium present forms a good test as to whether the revivification is being properly carried out. The mass must also be raked about and damped. When the material is completely exhausted it must be treated in precisely the same way—and this is a point often forgotten—otherwise it is not prepared for sale, and there is a risk of it becoming overheated in transport, and the Prussian blue is damaged. Even then it ought not to be kept too long in large heaps, for heating can even then occur; the finely divided sulphur begins to oxidize, and the heat accumulates, so that first the sulphocyanides go, then the blue, and last of all the whole mass may take fire. This has frequently been the cause of dispute with the buyers. It must not be forgotten that the product is a very sensitive and unstable thing, and a few days' carelessness may dissipate the value piled up during many months. The buyers get many samples which are parched, poor in blue, and rich in sulphide of ammonium, showing that they have been overheated; and the bulk is then usually worse than the samples, so that disputes ensue. Regeneration *in situ* is only a device to overcome the extra demand for labor on account of the insufficiency of the purifiers. It works very well in England with ½ per cent. of Brin's oxygen, and in Gottingen with 1½ to 2 per cent. of air and subsequent carbureting, and labor is saved; but it is difficult to prevent overheating and the production of sulphide of ammonium. Samples should always be average samples, very carefully taken from the whole mass, and then sent to the buyer in a glass bottle, or at least in a wood or tin box. Paper bags cause the sample to dry up; then the percentage is returned too high; then the bulk does not correspond to sample, and disputes ensue. As to the method of analysis, it is now recognized that Knublauch's is the best, and for uniformity's sake, at least, it is exceedingly desirable that only one method should be in use. But even this method is one which can only be properly carried out in laboratories which are working it every day; hardly in laboratories where a gas oxide sample comes in, say, once or twice a year.

The percentage of blue is not conclusively exhaustive as to the money value of the spent oxide; for poor oxide is as dear to work as rich, and the value of the unit must be less for poor than for rich products.

In the discussion, Dr. Lux protested against the condemnation of alkalinized purifying material. He said that with such material, in Hanover, in daily practice, the highest possible yield of Prussian blue (14 to 16 per cent.) was obtained, and that this high yield was due to the continuous and intense action of the purifying material, while other materials let a large part of the ferrocyanogen escape. The high percentage of sulphocyanides referred to was traceable to the presence of ammonia in the gas, not to the presence of fixed alkali in the purifying material.

Dr. Auerbach said that the useless material (sawdust, etc.), accompanying purifying material was a decided defect, and that the conditions of production of ferrocyanides were complex, and would be satisfactorily worked out only through the experience of a certain number of good and well managed gas works.

Recent Progress in Arc Lighting.

[Read by Mr. Elihu Thomson, before the National Electric Light Association.]

In recent years the tendency in series arc lighting with constant current has been to increase of voltage of the dynamo, and machines capable of working 125 to 150 arc lights in a series have been developed successfully. But the potential between terminals in such a case may be 7,000 volts—often too high for security, and in some places forbidden by special legislation. An ingenious method of employing such machines when, as is the case with the Brush machine, several commutators are present in series relation, has been devised by Mr. Green, of the Brush Company. This plan demands that separate pairs of wires be run from the machine to the switchboard for each circuit, but the unquestionable effect of the new connection is to limit the difference of potential which is possible to be manifested between any two parts of the circuit through the machine and lamps.

In such a system, evenly loaded, the highest difference of potential anywhere to be found will evidently be that required to run a series of

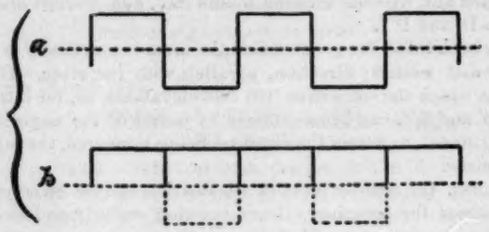

Fig. 1.

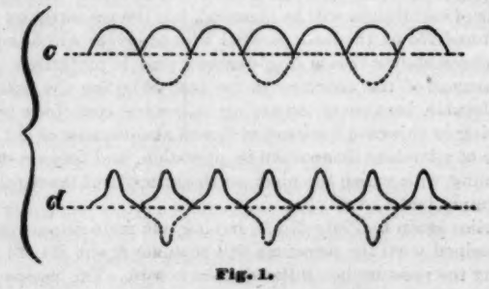

Fig. 1.

lights looped between two successive commutators. If lights are cut off from any set or loop, the potential difference between the terminals of that loop falls accordingly without any corresponding or proportional rise between any other parts of the circuit. If, however, lights are cut off one set and added to another, so as to keep the machine in full work with unbalanced loads, then the potential distribution is, of course, disturbed, and the system approaches the condition of all commutators connected directly in series, and the lights all in one series—the old plan. Where the conditions of the circuits leaving the station are such as to permit inductional effects on parallel wires—such as those of a telephone system—the new plan of circuit connections may give, as appears to have been already noticed, a greater inductive disturbance. This must be owing to the relatively simpler commutation per loop of lamps. In the old series connection all the commutators in series acted virtually as one of many segments, which tended to give a smoother potential, or prevent waves in the potential of the line. In the new plan each commutator of few parts acts, in a measure, independently of the others, and impresses its own variations of potential more directly on the lamp lines, giving rise to electrostatic inductional effects.

The immediate future of the series arc lighting system appears to be in the development of large dynamos, up to, say, 300 arc lights each, running at such speeds that one or a pair may be easily coupled directly to the shaft of a moderately high-speed engine. The use of a regulated constant current in the series system, besides giving a simple system as to wiring, etc., is seemingly best adapted to the use of the cheaper carbons. For extended districts the series arc lighting system is still likely to hold its own, but displacement by constant potential arcs and inclosed arcs on constant potential circuits will doubtless continue in cities supplied by underground low pressure systems with continuous currents.

Passing now to the consideration of the use of pulsating currents in arc lighting, it may be said that at present little or nothing has been done commercially in the United States in the use of such currents. The subject becomes one of importance in connection with what are known as rectifiers. These are machines that take an alternating current and commute the waves, or rectify them, so that the flow of current is in the same direction always, though rising from zero to a maximum for every alternation in an alternating current. The more or less near approach to continuity of current will depend upon the shape of the wave rectified. A rectangular wave, properly rectified, would, as in Fig. 1, give a true continuous current. Other forms of wave give less continuity, depending on the sharpness of the individual wave peaks, *c d*, Fig. 2. The character of arc produced by the rectified current resembles closely that of the continuous current arc, in that the crater in the positive carbon is present, and the negative tends to point itself. There is, however, a strong note or sound evolved from the arc, depending for its pitch upon the periodicity or frequency of the alternating current. The inductional effects of the pulsating currents in lines upon neighboring lines will, of course, resemble those of alternating currents, though less musical than the latter when a sound results, as in a telephone. In order to make it easy to commute or rectify such a high potential of alternating current as would be needed to feed, say, a series of 40 or 50 arc lamps with pulsating current, certain conditions are very desirable. One of these is that the current to be rectified should be of constant value, though alternating. The writer showed, nearly 10 years ago, how a constant current transformer could be made, using primary current at constant potential to obtain secondary constant current. One of the ways was to so mount a secondary coil, with relation to its primary, that repulsion might be exerted between them and so move one away from the other when a tendency to increase of current in the secondary took place. This method was found to be highly efficient, and was embodied in a number of forms of apparatus, some of which were employed to feed constant current to arc lamps in series. In this case lamps may be cut out and the secondary coil even short-circuited, while the current in it remains practically constant.

The above relates to the rectification of a single phase current. When, however, 2-phase or 3-phase currents are to be rectified, there will be at least two or three constant current transformers, one for each phase, and the secondary current may be combined through commutators resembling those of the Brush arc dynamo for the 2-phase, and the Thomson-Houston for the 3-phase. In such cases the resulting rectified current is much more nearly a steady or smooth current, and not so much of a pulsating character. This is, of course, owing to the relation of the phases being such as to cover each other's zeros or to overlap. Under proper working conditions there should be a certain field for the use of rectifiers in the United States, as well as in England, where Ferranti has for some time past had some of them in use. It is difficult to adapt a rectifier to periodicities of as high as 125 per second, but with 60 periods the problem is comparatively easy. The use of rectifiers has the one great advantage of permitting the generation of current in a station to be by means of large direct-connected dynamos, a portion of the output of which is used in the ordinary way to feed lights, etc., through the usual constant-potential transformers, while another portion, feeding rectifiers, supplies the arc lamps of the system instead of special arc dynamos, while, if needed, the whole capacity of the generator may be utilized for one or other kind of load, as desired.

The arc lamps worked by rectifiers are like continuous-current arcs in giving the downward distribution of light from the positive crater, a feature of great value in street lighting. There is also complete regulation—such that lights may be cut out *ad libitum* by shunting, while the other lights remain unaffected. Furthermore, the efficiency of the rectifier is high, and may easily be made over 90 per cent.

Two or more arc lamps are now often connected in a branch across constant potential mains or supply lines. Thus, on 110-volt circuits, two lamps using about 43 to 45 volts each, and with a proper choking resistance, may be found in the branch. On 220 volts there may be four lamps in a series, and on railway circuits of between 500 and 600 volts, 9 to 11 lamps may be found connected, with, in each case, a proper resistance.

The quality and character of the carbons used have a decided effect on the result as to steadiness and uniformity in constant potential arc work. Hence, a good cored positive and solid negative are desirable.

The distribution of current for arc lighting at constant potentials has undoubted advantages, one of which is the relatively low tension and absence of danger. Another is the facility of installation along with incandescent lights, and ease in metering the supply. The loss of energy in the distribution may, at full load of lines and moderate distances from the supply station, be, say, 10 per cent. or more, chargeable chiefly to feeder drop, and about 15 to 20 per cent. in dead resistance in the lamp branch. We may take, then, 25 per cent. as an average loss in reaching the lamps. This loss, which is much greater than the percentage of loss on the series system, is yet largely, if not wholly, made up by the superior efficiency of the constant potential, low pressure generators of large capacity over that of arc machines of relatively smaller output, and by the higher engine efficiency which may readily be attained in driving large generators, especially when working with economical loads. It must not be forgotten, however, that for equally good results a better and more expensive carbon will be required for constant potential work than for plain series arc lighting. These observations relate, of course, to ordinary open arcs with full supply of air reaching the hot ends of the carbons. The conditions existing with long-burning lamps or inclosed arcs will be alluded to later.

One serious objection to the arrangement of lamps in series between constant potential mains, especially those of 220 to 500 volts, is the inflexibility, or inability to cut off some lamps in a branch without substitution of equivalent resistance, which substitution, of course, means that the same watts are consumed whether the lights burn or not. We lose the advantage of the constant current system, which enables us to shunt lamps and save power, and also that of the simple multiple arc or parallel system at constant potentials, in which each lamp is in its individual branch circuit. Open-circuiting the branch extinguishes the light and saves power. With alternating current at constant potential there is greater flexibility, but, unfortunately no alternating current arc lamp is likely to equal in its effects lamps making use of continuous currents or undirectional currents.

There are two ways in which alternating currents may be used to work arc lights in series. We may either take a constant potential system, such as one with main lines at 1,000 volts, and connect between them a series of arc lamps at about 30 volts each and about 35 lamps, or we may transform so as to feed the lamps in series with a current of constant value, or with a current which does not vary more than a given per cent. from light to full load—15 per cent. for example. In the former arrangement some provision must be made to allow lamps to be extinguished without breaking the circuit, and this cannot be done by shunting unless equivalent resistances be substituted, for the shunting of a lamp or lamps in a series would result at once in a great increase of current in the others and a serious departure from normal working.

By shunting each lamp in the series by a specially constructed and carefully proportioned reactive coil, wound upon a laminated core, the difficulty just pointed out is obviated with but small sacrifice.

When a transformer is so constructed that there may be a considerable magnetic leakage, as it is termed, between the primary and secondary coils, it approximates what is called a constant current transformer. It will, if connected by its primary terminals across mains at constant potentials, give a secondary current which, even at short circuit, is only a moderate percentage in excess of that given when the secondary is carrying a considerable load.

In fact, such a transformer has an analogy which is unmistakable, to a direct current arc machine with a drooping characteristic, before alluded to. When, however, the amount of magnetic leakage in the transformer is carefully proportioned, or when, as in the rectifier transformer with repelled movable coils, the leakage is allowed to adjust itself, a substantially unvarying value of alternating current is delivered at all loads from short circuit up to the full load, or highest available working potential. The transformer then resembles an arc machine with an instantaneously acting and perfect regulator, or such a machine with a characteristic curve which droops vertically. This would mean the preservation of the same current at all potentials. By properly proportioning an alternating current dynamo, the same property of constant current has been given to the machine.

For arc lamps in series on alternating current, this constant current property is perfectly adapted. But in this case the regulation of the lamp must be by a shunt magnet responding to the potential across the arc, and not to the current passing through it, which is constant. Of course, the shunting reactances before mentioned might be used, but these would have no particular function in this case, since the system of supply permits free shunting of the lamps, and the current is the same even down to short circuit. Numbers of lamps were installed several years ago by the Thomson-Houston Company and worked in the way indicated, the transformers being of approximate constant potential property, but the writer does not know to what extent they are still in use. That the system is not entirely dead was indicated by a recent demand for additional transformers of the same type, though for quite a

period none was supplied or asked for. The system has its merits, like the series arc system with direct currents. It does not demand the highest grade of carbons, and the lamps are not liable to chatter at starting.

We may now consider the use of single arc lamps on the various circuit arrangements adapted to their supply. With the ordinary constant potential, continuous current circuits of about 110 volts, it is manifestly not desirable to operate a single lamp, taking, say, from 40 to 50 volts, and waste the remainder in resistance; yet, oftentimes, it is quite undesirable that two lamps in series be connected to the mains, on account of the inability to use one or both, and one may be quite enough. The gap is filled by the "inclosed arc," and, at the same time, the necessity of frequent trimming, a disadvantage with the open arc, is obviated. The inclosed arc lamp, broadly speaking, is an outcome of the ability to secure very nearly pure carbons, or carbons containing little or no ash and particularly free from such metals as iron, the oxides of which are deep black or brown, which would soon obscure the small globe around the arc.

The inclosed arc of to-day merits more than a passing consideration, on account of the general interest which has arisen in regard to it among electric light engineers. The idea of burning an arc in a practically closed and relatively small glass chamber is quite old.

Curiously enough, as late as about 1890, there was a revival of the inclosed arc as applied to arc light circuits in place of the ordinary series arc lamp. The sealing of the arc, so to speak, was such that about 65 volts were required to work it. A saving of carbons was effected, but the number of lights obtainable from an arc dynamo of any given capacity was seriously reduced, as was also the commercial value of any arc light line whose potential was limited either by law or circumstance. Contrary to the original expectation of its promoters, the use of inclosed arcs on series circuits did not progress rapidly and soon retrograded. Many causes, besides the one of reduced capacity of lines, had undoubtedly an effect. Cheap carbons for open arcs, impure carbons for inclosed arcs, breakage of inner globes—resulting in rapid consumption of carbon—obscuration of light, etc., must have contributed largely to the result.

When it is remembered that, to get the best results with arc lamps on constant potential circuits, the use of rather expensive cored carbons is necessary, the saving of carbon and frequent trimming becomes a very important item and permits the employment of more expensive carbons, provided they last long enough. The high voltage demanded by the inclosed arc was soon seen to be not a disadvantage, but a positive advantage for constant potential circuits, inasmuch as it permitted the use in one lamp of a larger fraction of the total—generally 110 volts. Hence, instead of keeping down the potential, it could even be raised from 65 to 75 or to 80 volts with advantage. In fact, it may be that the exclusion of oxygen has the effect of enriching the arc flame itself, in much the same way that a slightly luminous blue flame of a Bunsen burner becomes far more luminous by cutting off the air. There may, in fact, be free condensed carbon particles in the outer layers of the arc stream, highly heated, and therefore, strongly luminous. The flat ends of the carbons tend, also, to cause the hot gases to be retained under the positive end, thus extending the heat of the crater and increasing the luminosity. The result of the almost complete exclusion of oxygen is that very little combustion takes place and the life of the carbon is therefore much extended. The function of the small glass vessel around the arc is not only to keep out the air, but, in addition, to act as a diffuser of the light evolved, and in this sense replace, to a considerable extent, an opal outer globe of large dimensions, necessarily thick and highly absorptive. The inner globe around the arc is made thin, to withstand heat without cracking from sudden changes of temperature, and is generally of clear glass with a thin coating, either internal or external, of an opal or alabaster-like glass, which, by the materials employed in its composition, gives a large diffusive effect without undue absorption. The inner globe is often also given a yellowish color or absorptive effect for the disagreeable violet rays, of which the long arc flame is so strong a source.

Owing to the traverse from side to side of the arc between the square ended carbons, the direction in which light is emitted from the arc most effectively is undergoing continual and very great changes, so that the intensity of light in any given direction may, in a few seconds, vary several hundred per cent., and with a perfectly clear glass inclosing globe this variation would not only be quite noticeable, but in many cases intolerable. The diffusive power of the glass, however, is such, in the case of the opal coating, that the traveling of the arc is, in large measure, compensated, and the general effect is that of a very steady, uniform light. Were it not for the diffusive power, the color of light, as well as the intensity, would change greatly; as when the arc happened to be on the side of the carbons away from the observer, the light would then be in a greater proportion from the purple or violet arc flame, and less from the glowing ends of the carbons themselves.

The carbons to be used in an "inclosed arc" should be of the very highest grade as to purity, not too hard or dense, as straight as possible, uniform in diameter and circular in section, and should be obtained of as near a standard diameter as possible, so as to avoid the necessity for adjusting the caps of the inner globes to the size of the carbons.

The mechanism of an inclosed arc lamp to be run singly in branches from 110-volt circuits is naturally very simple. Since the lamp regulates entirely by variations of current on its circuit, simple series magnet suffices. No cut-out other than a fuse in the lamp branch is needed.

In the use of "inclosed arcs" instead of "open arcs," one does not escape from the necessity of using in the branch with the lamp a choking resistance. A constant potential circuit of 45 volts will not supply current to arc lamps demanding 45 volts at the terminals and approximately the same at the arc. By the use of resistance in circuit, however, and sufficient additional potential, the current, otherwise "unstable," becomes "stable," and the arc stable. It is possible, indeed, with especially sensitive lamp mechanism, to replace a part of the resistance needed by inductance, and thus save some energy. The "inclosed arc" also demands a sacrifice of energy in resistance, for a circuit of 80 volts constant potential will not run 80-volt arcs.

For the purpose of discovering the minimum drop of potential required to exist over a dead resistance in circuit with arcs on constant potential mains, the writer instituted and had tabulated a series of tests in which the resistance in circuit with arc lamps was gradually cut down along with the line voltage, while the current and voltage of the arcs were maintained the same. A set of tests was made with two Thomson '93 lamps in series, using at one time plain National carbons, and at another a cored upper of ½ inch diameter, and solid lower carbon of ½-inch diameter. Also a set of tests was carried out with 80-volt inclosed arc lamps adjusted for currents of different amount at different times. During each test the line voltage was lowered and resistance cut out until instability of arc and current resulted, while up to that time the current and voltage of the arc were kept the same during the particular test.

The tests were sufficiently accurate to show the main point very clearly. This is that a certain line voltage as a minimum is absolutely necessary in working arc lamps on constant potential lines, whether they be open arcs or inclosed arcs. Thus, two 45-volt arcs in series, with uncored carbons like the brand known as "National," cannot be safely worked below 110 volts on the line with resistance in series with them. More than 100 volts should, of course, be maintained for safety of the service.

The tests show, also, that, with a cored upper carbon, the limit is lowered several volts on the average, and it is known that the voltage of the arcs may be safely reduced somewhat when cored positives are used.

It is also shown that a 75 to 80 volt arc, run upon a constant potential line, is stable at considerably less line voltage than the open arc. It would appear, also, that, with either open or inclosed arcs at ordinary current strengths of from 5 to 10 amperes, the steadying resistance in the branch is required to cause a drop of about 15 to 20 volts, or waste energy at the rate in watts of 15 to 20 multiplied by the amperes of current used in the lamp.

The running of single alternating current arc lamps on constant potential circuits is facilitated by the ease with which, by a transformer or compensator, the potential required for the lamp may be obtained. It was natural that when arc lamps came to be used on constant potential, continuous current circuits, a demand for lamps which would work upon alternating circuits fed by transformer secondaries should arise. While in the direct current systems the potential was definite and practically could not be adapted to the lamp, in the alternating current case transformation was easy, as by the simple device of a compensator the line voltage could be raised or lowered to suit that demanded by the lamp. An arc lamp compensator is simply a laminated core bearing a coil divided into sections, with connections carried out between the sections. If the self-induction of the coil is proportioned for the secondary circuit voltage in a transformer system, as for 110 volts at the end of the coil, circuits of 30 volts may be obtained by taking three-elevenths of the turns as a secondary, that is, by connections which include between them any turns of the coil which equal three-elevenths of the total, or which give 30 volts. Moreover, several connections of the kind may be made to the same coil anywhere between its

ends, provided that the wire included between the two connections for one lamp circuit is sufficient to give the requisite voltage. Further, the sections of wire thus chosen may overlap each other, and portions of the compensator coil thus appear to be doing double or treble duty. Whether the current be furnished direct from the secondary of a transformer or through compensators, the lines led to the lamps are of constant potential character, and the lamps have to be adapted thereto.

The efficiency of the alternating arc as a source of light has been shown by Prof. A. E. Blondel, in a recent paper, to be quite variable. It depends on the length of arc used with the particular carbons employed, and on the diameter of the carbons, as with continuous current. It also depends on the form of the wave of the alternating current. It was found that, with a rectangular wave alternating current, such as may be produced by reversing a continuous current by a commutator, the light given out was as 79 to 59 in the case of sine wave currents. This should follow from the fact that the extinctions, as Blondel pointed out, were instantaneous in the first case, and lasted for about one-quarter of an alternation in the case of the sine wave.

The writer takes occasion to express the opinion that, with very flat-topped waves, or waves approaching closely to rectangular waves, the limit of periodicity would be found far below 40 per second, as regards the maintenance of an arc. If the reversal or passage through zero is quick enough, almost any reduction of periodicity would become possible. There are, however, practical considerations which set the limits in such a case. Soft carbons, of those best suited to readily furnish considerable volatile matter, seem to be best adapted to alternating current arcs, and they are frequently cored. The color of the light suffers some in consequence.

The use of single arcs across alternating constant potential mains requires only that the lamp mechanism be operated by variations of the current passing the arc. Hence, an electromagnet in series is used to lift and feed the carbons, or sometimes the expansion of a high-resistance wire, traversed by the lamp current, has been applied for the same purpose, as in the "Kester" lamp. In the use of a hot wire the objection of chattering at the start is overcome without difficulty, and the wire is noiseless in its action; but it demands that considerable energy be wasted in it, and hitherto the temperature at which the wire must run to secure sensitiveness of feed or rapid heating and cooling, following variations of current, has been such as to endanger its permanence or cause it to oxidize. If the arc requires 28 to 30 volts, and the regulating wire 5 to 7 volts, it is easy to see that a considerable sacrifice has been made for the result attained, particularly as in the use of a hot wire overfeeding is liable to take place. The writer obtained, a considerable time ago, a much better result by using the hot wire principle, but variably shunting it by a set of contacts controlled by a small electromagnet in series relation, which addition imparted greatly increased sensitiveness, while the slow start given by the hot wire was still secured.

The arc in the ordinary alternating current arc lamp appears to be stable, even when the connection is made across constant-potential mains without resistance or reactance in the branch as a check upon the current. Therefore, nearly all the energy may be thus delivered to the arc itself without deduction. This fact tends to neutralize the lower efficiency of light production in the alternating arc, since the continuous current arc on constant potentials involves a dead resistance loss. Any comparison, then, must, for practical purposes, consider the total energy used in the branch in which the lamp exists, and the light produced or emitted in directions permitting utilization.

While the alternating arc, run from constant potentials, is feasible, the difficulty of chattering and large variations of current at starting results from the arrangement, and any sudden fall of potential may cause a momentary extinguishment. Particularly is this the case when the arc is of the "inclosed," long-burning type. In such case, on account of the greater length of the arc, it is peculiarly sensitive to influences which would affect but slightly the ordinary open-air arc.

It is too early to predict what part the "inclosed" alternating arc may play in the future art of arc lighting, but it probably will find a considerable application.

When an alternating arc is run with a considerable dead resistance in series with it, or when a reactance coil is in series, or when it is fed from the secondary of a leakage transformer, taking the whole current thereof, the condition approaches, though in cases only imperfectly, the running of the lamp on approximately constant current. In reality, the condition is intermediate between constant-current and constant-potential working. In such a case the regulation of a lamp may be by a series magnet or a shunt magnet, or by a combination of both. In fact, there is no real utility in generating a constant current of alternating character for working a single lamp. The utility of the "intermediate" working, just alluded to, is in the lessened liability to rupture of arc, lessened chattering at starting, and avoidance of excessive flux of current if the carbons by accident come together. The condition is one decidedly useful in the case of the "inclosed arc" of alternating type, and it is doubtful if such arcs can be run except under conditions like those here called "intermediate." For saving energy, a reactance or reactive coil in the lamp circuit is preferable to a dead resistance, and is relatively more effective.

It may be well to add to the present paper, which has grown to unexpected length, a statement concerning the results arrived at by innumerable tests of the different types of arcs and arc lamps under conditions resembling those of practice, with a view of ascertaining their lighting values. These tests have been embodied in comprehensive reports by Mr. Jesse Coates, of the testing department of the General Electric Company, at Lynn, and the tabulated results might easily furnish material for a lengthy discussion. They embody complete series of measurements of candle power in various directions, and curves of the same for each kind of arc or condition of surrounding globe, together with mean spherical and estimated useful illuminating intensities. The methods of measurement cannot be detailed here, but are such as in the writer's judgment can be relied upon to give comparative figures. Moreover, the mean of many observations is in each case taken for comparison and plotting of curves.

The purpose here shall be to state in a general way some of the results obtained.

It is well known that the larger the arc, or the larger the current in it with a normal voltage, the more efficient is the light production. The energy is more effectively converted into luminous waves, so that the watts per candle would naturally be less with a 20-ampere arc at 48 volts than with 10 amperes flowing. Measurement shows that where, with continuous current, the same brand of hard carbons is used of diameters varying approximately with the current strength, naked arcs, with 10 amperes and 48 volts, may take for each mean spherical candle power 1.2 watts, while arcs of 7 amperes and 48 volts require 1.4 watts.

The use of a cored upper carbon appears to raise the efficiency to a moderate extent, probably because the arc may be maintained at a voltage somewhat less, as at 42 or 44 volts. The use of a clear globe surrounding the arc loses 10 to 12 per cent. of the light, while alabaster and opal globes lose from 45 to 65, according to their thickness and the specific absorptive power of the glass. Naturally, since an inclosed arc, consuming approximately the same energy in watts at the arc as a 10-ampere open arc, will have a current of only about 7½ amperes, the efficiency would be expected to be less. Measurements show, after a run of 102 hours, and per each mean spherical candle power of a 4½-ampere, inclosed, continuous current arc with clear inner and no outer globe (½-inch carbons), an expenditure of 1.94 watts at the arc. If the energy expended in the lamp branch be taken as the true expenditure, that lost in resistance is added to that of the arc, and the watts per candle increased accordingly. A similar loss is, of course, experienced with naked or open arcs on constant potentials, owing to resistance being used in series. The result given above, or 1.94 watts per candle, is at the end of a long run of 102 hours, but with a clear inner globe. Inclosed arc lamps with clear inner and clear outer globes are not satisfactory, and, in fact, for good results of uniformity and diffusion, a slightly opal inner globe is needed. Those now known as "alabaster" are well suited to the purpose. When these are used, the watts at the arc per mean spherical candle power will at the first part of a run range about 2 watts, increasing seriously only toward the very end of the run. While it may seem that the watts per candle are higher than might be expected, yet it must be borne in mind that in all inclosed arcs the current is relatively small and the potential high for a given expenditure of energy, and this acts in a double way to lower the efficiency, as not only the crater emitting light is smaller, but a large part of the energy goes to sustain the arc flame, which is long, while also, the absorption of light by the surrounding glass is not to be neglected. No construction of lamp, regulation or adjustment thereof, can get rid of the inherent properties here pointed out. Nevertheless, it is true that the character of the light, both of the open or exposed arc, and of the inclosed arc, is such as to make it very desirable as a subitute for daylight and for many cases of use. The fact that the light is shed mainly downward by continuous current arcs results virtually in an addition to the efficiency and economy of the light; thus, if the light emitted downward be considered as alone useful, the expenditure per mean useful candle would, with naked arcs, fall to about ½ a watt, and with inclosed arcs, to from 1 to 1½ watts at the arc.

With alternating arcs the conditions are different, since the light is sent up and down equally. By a reflector placed above the arc, a considerable fraction of the light which would often be lost upward is sent downward to increase the effectiveness; thus, a 16-ampere, 25-volt, naked alternating current arc used per mean spherical candle, 1.49 watts, or for mean useful below the horizontal, 1.12 watts, which was reduced to .8 to .9 watt when a porcelain reflector above the arc was used. For the same causes that necessarily reduce the efficiency of an inclosed continuous current arc as compared with the uninclosed, the efficiency of an inclosed alternating arc falls below that of the open arc with similar currents. The watts at arc per candle will be found, per mean spherical candle, to be under the best conditions about 2 watts, increasing toward the end of the run, owing to obscuration of the inner globe and other causes. No reflector or deflector can be used with much effect with the inclosed arc, so that the mean useful is but little different from the mean spherical candle power.

The apparent advantage in economy of the continuous current inclosed arc over that with alternating currents is in large measure neutralized by the fact of the former requiring a dead resistance in circuit to give stability to the current, while the latter can be run without it, or, at most, with a reactive coil which wastes but little energy.

It should be said, in conclusion, that the figures given above and expressing the watts per mean spherical candle, while strictly comparative so far as a study of arc lights alone is concerned, might vary somewhat if the object had been to compare arc and incandescent lights, owing to the difference in color of light, though the variation would not in any case be great.

The Commercial Uses of Coal Gas.—No. V.[1]

By Mr. Thos. Fletcher, F.C.S., in the *Gas World*.

The economy in the use of an open gas flame for many commercial processes is undoubted, but, up to the present, it has had the very serious drawback, in enamelling and many other industries, that the flame produces the effect technically known as "gassing," *i. e.*, it discolors and alters the composition of many of the compounds exposed to its action, and the expensive muffles, also necessary with coal or coke, cannot be dispensed with. One of the disabilities which frequently crops up is the fact that a reliable weld cannot be obtained with iron or steel, owing to the formation of magnetic oxide on the surfaces exposed to the flame. This latter defect appears to be incurable, so far as is known, but in other directions some success has been obtained, although to a limited extent. In the finishing of the cut edges of glass tumblers, which are made by the million, repeated attempts have been made to use gas for "flashing" the edges, with the result that, especially in flint or lead glass, which is universally used for the best work, the brilliance of the glass is seriously affected. Small pots and "glory holes" have been made which work satisfactorily in the manufacture of Venetian glass, but these, up to the present, have been all made to exclude the products of combustion, and the cost is consequently very much increased. That this disability is permanent I very much doubt, and that it will be eventually overcome I think is only a question of time and experiment. The trouble is that, for work of this kind, experiments are costly, and the result to the experimenter is small; the gas works get all the profit, and therefore the matter is neglected. An appliance which, after costly experiments and repeated failures, shows a profit to the maker which would recoup his expenses out of pocket in a few years, whilst every one made is producing a profit to the gas company of more than its total cost every month, is one not likely to get the attention it requires to make it a success.

The Sealing Wax Trade.—It is not necessary to describe the various arrangements for warming plates and vats by the use of ordinary burners, but one arrangement is worthy of mention—*i. e.*, the polishing of the sticks after they are moulded. Many methods have been tried, but the person who originated the use of a gas griller or toaster for flashing the polish on the sticks was an original genius whose name should have been handed down to posterity. A special arrangement for this is desirable, with an open back, to enable the trays of sticks to be passed through from back to front, or the reverse.

The Use of Coal Gas for Sterilizing and Disinfecting.—Some years ago there was a fad for disinfecting the air from sewers. This could only have emanated from those who had no proper knowledge of the subject; the apparatus made and sold was, for all practical purposes, inert, and why so many of these appliances were purchased, without proper inquiry, is a matter almost beyond comprehension. In a similar way, ovens have been made and sold, for disinfecting clothes in workhouses, which were, and are still, a constant danger to the community. It has been repeatedly proved that clothes and bedding cannot be safely disinfected by dry air, and that the only method known was to use steam under a low pressure. Recent discoveries have overcome this difficulty, and now the use of formalin, or formaldehyde, is known to be safe, certain and cheap. The use of gas is out of the question, and when it is proposed every effort should be made to prevent what can only be a dangerous thing. A disinfector in an infectious diseases hospital, and which does not disinfect, is as dangerous as an unexploded shell in a heap of scrap iron, if not more so, as the harm it may do is incalculable.

Heating Caustic Liquors and Chemicals.—For most purposes of this kind, high temperatures are not required, and the usual methods are cumbrous and costly. One hole only is necessary for the circulating pipes, from a small gas heated boiler, the flow and return passing through the same plug, side by side. This pipe needs to pass only once round the bottom of the vat, as the heat is rapidly absorbed; and the pipes may be made of pure tin, lead, or other suitable metal. To prevent the necessity of breaking connections for cleaning out, a plug should be fitted in the bottom of the vat, so that a hose pipe and brush can be used.

Metal vats are much more economically heated by placing the gas burners underneath; but it must not be forgotten that wrought iron vessels, whether galvanized or not, are rapidly acted on by the condensed products of combustion from gas, and this must be considered a factor in the arrangement. Cast iron lasts, under precisely the same conditions, for very long periods. It is not generally known that a coating of tin on wrought iron plates affords a very decided protection from the corroding action of condensed water of combustion, whilst galvanizing, or coating with zinc, is almost useless, the zinc rapidly disappearing. Galvanized iron water vessels should not be heated over a gas flame in regular commercial use, and tinned iron is quite as objectionable, if not more so. The tinned sheets of commerce are made from steel, and the coating is rarely perfect; minute holes are almost invariably present, and these show rapidly as rust spots, which quickly penetrate through the plate. The only remedy is to dry the tin vessel after use, and this is so troublesome that, in practice, it is never done. The cheapest metal to use for this work is copper, and nothing else should be recommended. The best is aluminum, but its price is at present prohibitive, and owing to its softness it will not bear regular use unless very thick; the smallest pans should be at least ¼-inch thick, and larger ones in proportion. Pure nickel would be perfect but for the fact that it is readily soluble under certain, or rather uncertain, conditions, and the result is poisonous; it must never be used under any possible circumstances for vessels which contain food.

Confectioners' Ovens.—For light, puff pastry, having the finish required for trade and shop window purposes, one of the first essentials is a sharp top heat. For this reason the coal and coke fired ovens are made very low in the crown, and when externally fired, as they must be for continuous use, the flues are taken over the arch. The trays carrying the pastry are all on one level; the usual overshelf of the ordinary gas oven will not produce the finish and appearance required, for the simple reason that the steam rising from the lower layers envelops the upper ones and prevents the dry crispness required. Confectioners frequently buy, or hire, ordinary gas cooking ranges, and naturally are disappointed with the result where well-finished work is required. When gas is used for this class of work it is possible to bake two heights of puff pastry, provided the oven is specially designed for the work. The only practicable way known at present is to heat the bottom of the oven externally, covering this with a layer of tiles to prevent excess of bottom heat, and then to lead the burned gases to the top of the oven, *inside*, and to carry these away from the oven bottom level, giving a descendent heat. This complicates the oven construction, and increases its cost, but the fact that two shelfuls can be baked on the same floor space as one by the old method is sometimes a matter of importance. Failing this arrangement, it may be taken, as a rule, that for shop work of the highest class and finish only one shelful can be baked at one time, and this must be placed as near the top of the oven as possible. It must be clearly understood that these remarks apply only to work which has to be finely worked off, in the style which is necessary for high-class trade, where appearance is at least as important as quality, if not more so. Confectioners often obtain gas-heated ovens under the impression that an ovenful of light pastry can be finished as well as a single layer in the old form. This is a mistake; the steam from one shelf always affects the other, and the damp heat resulting gives, even in the most experienced hands, a second rate result so far as experience goes.

1. For No. IV., see Journal, June 7, 1897, p. 919.

Drying Bacon, Glue, Gummed Papers, Etc.—This class of work, which has to be done on a large scale by dry air at a comparatively low temperature, cannot be economically done by gas. If the direct flame is used, the moisture formed by the gas combustion is objectionable; and if a stove is used, keeping the products of combustion away, the expense is seriously increased. The best method is to use steam pipes, if they are available, and, failing these, a slow combustion coke stove, with a long horizontal flue pipe at as low a level as possible. Gas coke is a perfectly satisfactory fuel for this purpose, but, as dust must be avoided, the feed door and ash pit must not open into the drying room. Occasionally this arrangement is a difficult one to carry out in unsuitable buildings, and gas heating arrangements have been tried, the result being the removal of the apparatus when its cost has been discovered.

Greenhouse Heating.—One cubic foot of gas per hour will maintain a rise of 1° F. for every 450 square feet of glass on a calm day with no wind, but at least double this power must be provided for windy weather. The average working practice is 1 cubic foot of gas per hour for every 300 square feet of glass, and one-third of this extra for exposed outside walls. Greenhouses heated by gas are frequently worked so as to be very unnecessarily expensive. It may be taken, as a rule, that no plant house heated by gas should be kept at a higher minimum than 45° F. If this is strictly observed, the time during which the heat is required will not average, in the Midlands, more than a total of 6 to 8 weeks per annum. If a higher temperature is kept, the extra gas required for the same period is not a serious matter, but the time during which the heat is required is enormously increased; a minimum of 55° would extend the time to nearly six months, and a minimum of 70° would mean hard firing, day and night, for almost the whole of the year. Inattention to this important point means excessive cost, and consequent discarding of what, under reasonable conditions, would be found a great pleasure and convenience.

The Uses of Coal Gas to the Burglar.—This title is not very reassuring, but it is, perhaps, the most correct one; and with it I shall close these notes. With a small gas supply, or a small cylinder of compressed gas and one of oxygen, a small blowpipe, adapted for this mixture, can be made to penetrate the hardest drill proof steel plates. Safes made of the hardest drill-proof steel, if not over half an inch in thickness, can be fused with the greatest ease. The pattern made for commercial use is very noisy, but a perfectly silent form is also made, and can be obtained in ordinary commerce. Safe makers know this, and the best safes are now made of plates which are too thick for the blowpipes to deal with. In ordinary use these tools are made for cutting steel bolts in difficult positions, brazing up leaks and making repairs in pipes and fittings of engines, without taking apart, which is often a very serious matter in marine engines as at present constructed, and other works of a similar nature.

Production of Coal in the United States During 1896.

The *Engineering and Mining Journal*, in printing the accompanying statistics, gives the tables of the total production of coal and coke in the United States for 1896, as collated for the Fifth Volume of The Mineral Industry. The figures have been completed, with the single exception of Ohio, for two months past. The publication of the table has been postponed for that time by delay in obtaining the official statement for the important State of Ohio, which was not finally furnished until a few days ago. The tables are made up from the official figures of the mine inspectors and other State authorities and direct returns from producers, and are, we believe, accurate.

Perhaps the most notable fact shown by the table is the relatively small change in the total production as compared with 1895. The last-named year was one in which there was very considerable—though rather spasmodic—activity in the iron trade and some other branches of manufacture, while 1896 was a year of continued and almost uniform depression; but there was last year a decrease of only 1¼ per cent. in the production. Moreover, this was entirely in anthracite coal, the output of bituminous coal, the fuel of manufacturing being almost the same in 1896 as in 1895. The change was an increase of 244,702 short tons only.

To sum up the table briefly, the total production of coal in the United States in 1896 was 186,241,271 short tons, or 168,957,264 metric tons, of which 137,331,048 short tons were bituminous coal, 48,855,563 short tons anthracite, and 54,660 short tons cannel coal. The total was less than that of 1895 by 2,812,119 short tons, but was greater than that of any year previous to 1895. The value of this coal, or the returns made at the mine, reached a total of $203,182,972; a sum great in the aggregate, but returning only the small average of $1.09 per ton to the operators, and the average price of bituminous coal, which alone is to be compared with the coal of other countries, was only 84 cents per short ton, or 92 cents per metric ton.

With the exception of Great Britain the United States is by far the largest producer of coal in the world. At the rate at which production was increasing for the ten years prior to 1893 it was anticipated that in four or five years—at any rate before the year 1900—the lines of output would cross and this country would pass its chief rival. Three years of depression here, and of prosperity abroad, have postponed the time when the United States shall take the lead; but it is still possible that it may come with the end of the century. The difference between the two countries is that Great Britain has reached very nearly the limit of its yearly production, while in this country a very great and rapid expansion is possible whenever demand may justify it. When business revives here, an addition of 10,000,000, or even 15,000,000 tons to our output in a year would not be impossible, nor even extraordinary. The fact that the change last year was so small again brings us to the conclusion that trade depression is marked less by an actual decrease in production than by an absence of the normal growth of ordinary times, and by a reduction in profits.

The table shows that our supply of fuel in this country is cheap as well as abundant. As noted above, the average return per ton at mine last year was $1.09, but this was brought up by the higher prices of anthracite. The average for all bituminous coal at mine was 84 cents, and this was above the amount reported for several of the States. Thus, among the important producers we find that Pennsylvania bituminous brought an average of 66 cents only; West Virginia, 70 cents; Illinois, 72 cents, and Ohio 78 cents. No State east of the Mississippi shows an average as high as $1 per ton. In contrast with the general tendency anthracite showed a higher average in 1896 than in the previous year—$1.80 against $1.50—which was due entirely to the action of the companies controlling the trade in restricting production and maintaining prices.

Pennsylvania is the greatest coal producing State, furnishing last year 36.6 per cent. of the bituminous coal, and 53.1 per cent. of the total, including the anthracite. Illinois holds the second rank, though its total output is only one-fifth of that of Pennsylvania. Ohio comes third and West Virginia fourth. It is to be noted that the Ohio production showed a considerable decrease in 1896, while West Virginia not only held its own but made a slight gain. No other State outside of these four reports a yearly total over 5,000,000 tons, with the exception of Alabama.

To some extent the varying currents of trade can be traced in the production of the different States. The decrease in Pennsylvania bituminous is more than accounted for by the smaller amount taken for conversion into coke for the iron trade. The condition of that trade may partly account also for the decrease in Ohio, though very little coke is made in Ohio; but in part also that was due to a loss in the Lake trade through the competition of the Pittsburg region, and to a lesser extent, of West Virginia. Coal from the last-named State now reaches the Lakes and finds markets as far west as Chicago, notwithstanding the longer haul required, its advantage in quality over the Indiana and other Western coals being generally recognized. West Virginia, indeed, is a disturbing factor in both the Western and the seaboard coal trades; its low mining costs and the character of its coal, together with the central position of the State and its railroad connections, enable the operators to cover almost the entire territory from the Atlantic ports to Chicago at will.

In the Southern States the production was maintained about on the same level as in the preceding year, Kentucky and Tennessee showing little change, while Alabama reports an increase. The production of the other States is not important. The Alabama operators no longer depend so entirely on the iron trade as formerly. They have extended their shipments to the Gulf ports and are beginning to take a share of the Mississippi River trade, which was formerly an exclusive field of the Pittsburg people.

Some of the Western States show unexpected changes. While there was a small decrease in Indiana's production last year, Iowa, Missouri and Kansas changed very little, and Illinois reported an increase of 2,050,762 tons, or much more than any other producing district. It is not easy to account for so great a gain, though it was probably due in part actually to the trade depression and general tendency to economize, which forced the extended use of the local coal in Chicago and other cities in place of the more expensive anthracite, which there finds a considerable sale for domestic use in ordinary times. Very

Total Production of Coal in the United States. (In tons of 2,000 pounds.)

States.	1895. Tons.	1895. Value. Totals.	1895. Value. Per Ton.	1896. Tons.	1896. Value. Totals.	1896. Value. Per Ton.
Bituminous—						
Alabama	5,680,410	$5,680,270	$1.00	5,747,698	$5,460,314	$0.95
Arkansas	797,424	1,993,569	2.50	889,750	2,001,937	2.25
California	80,115	240,345	3.00	69,449	158,135	2.25
Colorado	3,449,000	4,242,270	1.23	3,312,000	4,968,000	1.50
Georgia	414,310	364,593	0.88	246,012	214,030	0.87
Illinois	a17,735,864	16,316,995	0.92	a19,786,626	14,246,370	0.72
Indiana	4,312,084	4,096,480	0.95	4,068,124	3,152,796	0.77
Indian Territory	a1,228,440	1,904,082	1.55	a1,235,333	1,914,766	1.55
Iowa	a3,995,836	5,076,434	1.27	a4,004,508	5,085,725	1.27
Kansas	3,190,843	3,590,141	1.13	3,141,343	3,253,583	1.03
Kentucky	3,138,023	2,573,179	0.82	3,128,818	2,346,623	0.75
Maryland	3,479,499	3,061,959	0.88	3,627,425	3,192,130	0.88
Missouri	a2,283,081	2,625,543	1.15	a2,420,147	2,883,169	1.19
Montana	1,104,854	2,300,300	2.08	1,157,722	2,262,768	1.96
New Mexico	367,442	551,162	1.50	332,600	465,640	1.40
North Carolina	15,386	24,771	1.57	14,970	23,203	1.56
North Dakota	79,850	99,475	1.25	94,500	103,950	1.10
Ohio	13,683,879	11,904,975	0.87	12,912,608	10,071,834	0.78
Oregon	65,918	131,836	2.00	60,739	121,478	2.00
Pennsylvania	51,813,112	36,787,310	0.71	50,273,656	33,180,613	0.66
Tennessee	2,319,720	1,809,382	0.78	2,663,714	2,024,422	0.76
Texas	499,668	1,064,293	2.13	585,000	1,228,500	2.10
Utah	530,713	769,533	1.44	429,446	519,801	1.21
Virginia	1,083,229	812,421	0.75	1,018,237	763,677	0.75
Washington	1,184,619	3,553,857	3.00	1,295,313	3,562,110	2.75
West Virginia	12,355,113	8 895,681	0.70	12,541,382	8,778,967	0.70
Wyoming	2 197,914	3,077,080	1.40	2,273,928	2,946,106	1.30
Total bituminous { Short tons	137,086,346	$123,547,936	$0.90	137,331,048	$114,930,647	$0.84
Total bituminous { Metric tons	124,363,917	.....	1.00	124,585,909	.....	0.92
Cannel—						
Kentucky { Short tons	69,747	191,804	2.75	54,660	146,488	2.68
Kentucky { Metric tons	63,274	.....	3.03	49,587	.....	2.95
Anthracite—						
Arkansas	103,247	309,741	3.00	103,420	310,260	3.00
Colorado	133,393	373,500	2.80	59,600	149,000	2.50
Pennsylvania	51,660,657	79,567,411	1.54	48,692,543	87,646,577	1.80
Total anthracite { Short tons	51,897,297	$80,250,652	$1.54	48,855,563	$88,105,837	$1.80
Total anthracite { Metric tons	47,080,919	.....	1.70	44,321,476	.....	1.98
Grand total coal { Short tons	189,053,390	$203,990,392	$1.08	186,241,271	$203,182,972	$1.09
Grand total coal { Metric tons	171,508,110	.....	1.19	168,956,972	.....	1.20

a. Fiscal year.

Total Production of Coke in the United States. (In tons of 2,000 pounds.)

States.	1895. Tons.	1895. Value. Totals.	1895. Value. Per Ton.	1896. Tons.	1896. Value. Totals.	1896. Value. Per Ton.
Alabama	1,232,242	$2,094,811	$1.70	1,247,028	$2,057,596	$1.65
Colorado	310,950	621,900	2.00	324 700	974,100	3.00
Georgia	90,620	144,086	1.58	55,467	88,737	1.60
Illinois	3,200	5,280	1.65	2,900	4,640	1.60
Indiana	4,760	8,330	1.75	4,890	7,610	1.55
Indian Territory	7,000	16,590	2.38	7,156	16,816	2.35
Kansas	8,350	16,700	2.00	8,147	16,294	2.00
Kentucky	25,453	40,725	1.60	24,519	36,778	1.50
Montana	61,378	506,417	8.25	63,694	461,260	7.26
New Mexico	1,309	3,024	2.31	779	1,791	2.30
Ohio	17,150	27,905	1.59	16,184	27,998	1.73
Pennsylvania	8,922,329	12,848,154	1.44	6,613,180	10,581,088	1.60
Tennessee	371,740	557,610	1.52	332,746	499,019	1.50
Utah	34,265	75,383	2.20	32,491	71,480	2.20
Virginia	137,826	203,982	1.49	131,400	193,138	1.47
Washington	7,318	43,918	6.00	22,368	89,472	1.45
West Virginia	1,248,574	1,785,461	1.43	1,452,392	2,105,968	4.00
Wyoming	9,000	18,000	2.00	19,543	38,086	2.00
Total coke { Short tons	12,493,464	$19,018,276	$1.52	10,389,584	$17,271,871	$1.67
Total coke { Metric tons	11,333,996	.....	1.68	9,398,153	.....	1.84

little Illinois coal goes out of the State except to Wisconsin, on the north, and to the city of St. Louis. The adjoining States to the east and west are coal producers themselves, and the quality of the coal is not such as to permit it to compete in more distant markets.

In the Rocky Mountain region Montana and Wyoming showed gains in 1896 and Colorado a decrease, but none of the changes were of importance. On the Pacific Coast Washington showed a larger production in 1896, but the output of Oregon and California continued small. The reliance is still largely on British Columbia and other foreign mines.

The coal production of the United States is very nearly the measure of its consumption, both imports and exports being small. In 1896 the former, chiefly at the California ports, reached a total of 1,349,557 tons, while the exports, which nearly all went to Canada, were 3,626,202

tons. The difference of 2,276,645 tons was only 1.2 per cent. of the total production. Notwithstanding our cheap and abundant coal and ready transportation to deep water, our coal exports do not increase. Outside of the shipments to Canada, which are made chiefly by rail or by the Lakes, our export trade is made up chiefly of a few cargoes yearly to the West Indies and South American ports. Coal can probably be put on board ship more cheaply at Norfolk, Newport News, Pensacola, Mobile, Philadelphia, Baltimore or New York than at any ports in Great Britain; but that country still continues to supply customers with coal all over the world, while our trade is comparatively nothing.

The anthracite production, which was carried up to the highest point ever known in 1895, showed last year a decrease of 5.9 per cent. Experience had taught the producers that remunerative prices could not possibly be maintained with unrestricted production, and an opposite policy was adopted, an informal agreement being generally observed by the companies.

The coke production of the United States is shown in the second table, by States. As compared with 1895 there was a decrease in production of 17 per cent. The coke trade is so closely allied to the iron industry, and so dependent upon the demand from that industry, that a decrease was to be expected. Nevertheless, there was an increase in the average price, chiefly because of the persistence with which the producers who control the Connellsville region maintained their schedule.

Pennsylvania continues to be the chief coke producer, furnishing about two-thirds of the total and nearly all the decrease in production was in this State. There are already indications of approaching exhaustion of the coal deposits in the Southwestern part of the State, from which the Connellsville coke is made, and some of the large operators of that district have already been buying property in West Virginia; and that State may in time become the leading coke producer.

The year 1896 was one of sharp competition, low prices and unsatisfactory results of coal operators and miners all over the country. That it was not a year of serious labor troubles also was due to the apparent hopelessness of strikes probably more than to any other cause. Production was not interfered with by any cause except the decrease in demand. That there were no greater changes than those shown in our tables must be considered as the most notable incident of the year.

The Agricultural Value of Sulphate of Ammonia from Blast Furnaces.

At a meeting of the British Iron and Steel Institute, held in London during May, Mr. F. J. R. Carulla, F.C.S., handed in a paper on the subject named in the heading. The author said that the hazy ideas that prevail on the subject of nitrogenous manures among farmers seems to call for more accurate knowledge on the part of those who produce these commodities in order that they may be able to educate their customers. It is therefore especially necessary for ironmasters, who have now become such large makers of sulphate of ammonia, that they should not harbor any doubts as to the true value of this product as a fertilizer for agricultural purposes. The nitrate of soda producers have, by their most praiseworthy efforts, succeeded in creating quite a literature on their special subject; and sulphate of ammonia is being left behind, more because nitrate of soda is so persistently pushed to the front than because of any inherent deficiency in its intrinsic value. Meanwhile, many sulphate of ammonia makers quietly accept the situation without protest—some, indeed, almost appearing to be converted to the new theories.

Until very recently, it was always acknowledged that ¼ cwt. of sulphate of ammonia was equal in fertilizing power to 1 cwt. of nitrate of soda; or, to be perfectly safe, say that 4 cwt. of sulphate equalled 5 cwt. of nitrate. However, since iron blast furnaces have begun to send their make into the market in increasing quantities, the intrinsic value of sulphate of ammonia as a fertilizer appears to have so diminished as to have become equal to that of nitrate of soda, weight for weight. Surely no one will say that this can be due to any inferiority in the product from blast furnaces. Yet the increased make and the apparently diminished intrinsic value are contemporaneous events that would lead a superficial observer to that supposition. It is easy to say that over-production is at the bottom of the mischief; but that is not all. Our friends the nitrate of soda producers have gradually won for themselves a position of pre-eminence that they now stoutly try to maintain, and do so successfully at the present moment. No less an authority than the Secretary of the Permanent Nitrate Committee, replying to certain correspondence on the subject of sulphate of ammonia as a fertilizer, said in the Birmingham *Daily Post* of February 20, 1897: "For the majority of purposes, nitrate of soda, weight for weight, is practically of greater value to the farmer than sulphate of ammonia." You will thus see that the point has not been overstated; for sulphate of ammonia has not fallen from its former position to be the equal of nitrate of soda, but has even come to be regarded as its inferior. The public seem to share in this belief, for they gladly pay more for nitrate of soda than for sulphate of ammonia, so great is the power of advertisement.

It will occur to anyone who gives the matter careful thought, that no better proof could be adduced of the equal intrinsic worth of the unit of nitrogen in the two manures than the fact that no difference is made between them in the Fertilizers and Feeding Stuffs Act passed in a recent session. If there really be any material difference between them, and the unit of nitrogen in nitrate of soda is really worth more than is the same unit in sulphate of ammonia, what can the Nitrate Committee have been doing to allow the bill to pass through Parliament without protest? It was not a bill of which they could have been ignorant. This view was promulgated during a discussion before the Nottingham Section of the Society of Chemical Industry at Burton-on-Trent in January last. Expression has been given to it, besides, in the newspapers since that date whenever opportunity has offered. No reply has, to the author's knowledge, been vouchsafed to the argument; and he therefore ventures to advance it as an important proof of the equal value of the unit of nitrogen in the two fertilizers.

It may here be mentioned that Mr. James O'Sullivan, during the discussion referred to above, expressed the opinion that the great obstacle to the spread of the use of the sulphate of ammonia in this country was its name, and that if it could be re-christened, so as to convey the idea of nitrogen in the same way that the word "nitrate" does, it would be a good thing. Accepting this view as in some measure explaining the anomalous position of the two fertilizers towards each other, the author suggested that sulphate of ammonia should be called "Nitrogenous Sulphate" for the purpose of sale among home farmers. No one would be able to say that he is in any way misled; for a substance which contains upwards of 25 per cent. more nitrogen than nitrate of soda, and which is besides the richest nitrogenous manure available, is surely entitled to be so called. When one considers how successful the application of suggestive names has been in other departments of industry and of commerce, it must be admitted that the neglect of sulphate of ammonia, with its nearly 21¼ per cent. of nitrogen, for nitrate of soda, which barely contains 16¼ per cent., may in part be due to prejudice created by the persistent drumming of the nitrogen idea on behalf of nitrate of soda, which a change of name, making it also prominent for sulphate of ammonia, might remove.

It will naturally be asked: What is the result of comparative experiments made with the two fertilizers? A search has been made with the object of answering this very pertinent question. But as sulphate of ammonia made its way more by its own intrinsic worth than by the praises of its friends, there is very little specially written on the subject. Perhaps this is not altogether a disadvantage, as one is thrown on the nitrate of soda literature, which has been largely added to by the award of considerable money prizes for essays showing its value as a fertilizer. Such works must necessarily be looked upon as biased in all that relates to nitrate of soda; but nothing can impair the worth of statements made in them that tell in favor of sulphate of ammonia.

Professor Paul Wagner, Director of the Agricultural Research Station at Darmstadt, in his work on "The Increase of the Produce of the Soil through the Rational Use of Nitrogenous Manures," though showing a decided bias for nitrate of soda, gives, in the true scientific spirit, results that must cause astonishment to those lukewarm friends of sulphate of ammonia who, little by little, are being converted to the belief that nitric nitrogen, as it appears in nitrate of soda, is more effective than ammoniacal nitrogen. Professor Wagner carried out or initiated during two years tolerably comprehensive experiments on the effect of manuring with ammonia as compared with manuring with nitrate of soda; and he gives the result of his researches in a table which shows in the most convincing manner the practically absolute identity of value for the unit in the two forms of nitrogen. He says: In my researches, which were carried out with grass, oats, rye, buckwheat and rape, usually no considerable difference between the effect of ammonia and that of nitrate showed itself, if the manure was applied in spring, and immediately before the sowing, to a clayey soil which contained a small percentage of carbonate of lime. In several series of experiments, the effect of ammoniacal nitrogen (*b*) was fully equal to that of nitric nitrogen (*a*), as the following examples will show:

Manure, Nitrogen, per Acre. Lbs.	Yields of Rye. (a)	(b)	Yields of Grass. (a)	(b)	Yields of Buckwheat. (a)	(b)
18	43.1	47.4	..	..	35.9	37.2
27	50.0	51.7	..	..	41.8	39.7
36	56.4	55.6	15.0	15.7	45.7	45.6
45	58.1	58.2	17.0	16.9	46.1	48.4
54	62.8	61.6	17.5	18.4	51.8	53.3
63	..	..	18.7	19.3	..	..
72	..	..	20.6	20.8	..	..
0	38.0		7.6		31.5	
Average..	54.1	54.9	17.8	18.2	42.3	42.8

It may be advisable, in order to prevent any possible misconception, to repeat that ¾ cwt. of sulphate of ammonia is practically equal in nitrogen contents, and consequently in fertilizing power, to 1 cwt. of nitrate of soda. It would be in this proportion that the two manures were applied in the various experiments of which the results are given in the table.

Can anyone after this doubt the practically equal efficacy of the same amount of nitrogen, whether present in a manure as nitric acid or as ammonia? No cases of failures can affect the value of such a series of results. All that can be said, if failure occurs, is that the proper conditions have not been present to make the nitrogen available. Cases in plenty are to be met with where nitrate of soda has not yielded the result that was properly expected from it; and this may also happen with sulphate of ammonia. It would be just as fair to infer from experiments performed under unfavorable conditions that the nitrogen in nitrate of soda is inferior to its value in normal experiments as it is to do this in the case of sulphate of ammonia under similar conditions.

As an example of the extreme unfairness with which facts may be presented so as to injure sulphate of ammonia (possibly without any real intention to do so), the following extract from the work above quoted will show:

Some experiments which I carried out with winter rye gave the following numbers as the averages of four closely agreeing parallel experiments. Every 10 pounds of nitrogen as compared with no manure gave the following increase in the crop:

	Grain. Lbs.	Straw. Lbs.	Grain and Straw. Lbs.
1. No nitrogen in autumn, all the nitrogen given in spring in the form of nitrate of soda	215	729	954
2. All the nitrogen given in autumn in the form of sulphate of ammonia, no nitrogen in spring	41	169	210
3. The smaller part of the nitrogen given in autumn in the form of ammonia salt, the larger part in spring as nitrate of soda.....	145	575	720
4. The smaller part of the nitrogen given in autumn in the form of nitrate of soda, the larger part in spring, also as nitrate of soda.....	156	594	750

Of course, it may be answered to the charge of unfairness in the way the above experiments are presented, that they were conducted on the assumption that the nitrogen was equally effective in whatever form given, and that they really only show that it is simply waste to give it in autumn in any form. That it makes little difference in what form it is administered, experiments three and four pretty well prove. Just consider, however, the effect produced on the ordinary reader on instituting a comparison between experiments one and two. The fact that, in the first case, the nitrogen from the nitrate of soda was presented to the plants at the most favorable period, and that the opposite was the case with the sulphate of ammonia, will avail little in the long run. The majority of readers will simply remember the good effect produced by the nitrate of soda, and the failure of the other manure. Nothing better than this example could be adduced to show the crying need for books written in the interest of sulphate of ammonia to distribute among farmers. Almost everything that now reaches the gardener and agriculturist is written in the interests of nitrate of soda. So much is this the case, that articles in popular papers are to be found in which the chief chemical manures are described without even mention being made of sulphate of ammonia.

The object of this paper is to direct earnest attention to this anomalous state of affairs in regard to so valuable a bye-product; to give reasons why such an unfair condition of things should not continue; and, if possible, to initiate a discussion that may help to bring about the much desired improvement. It may, however, be added, that so great has been the benefit rendered by two of the newest industries—viz., the manufacture of basic steel, and the recovery of bye-products from blast furnace gases—to agriculture, the oldest of them all, that, with basic slag to be used in the autumn and sulphate of ammonia in the spring, the farmer can now provide himself wholly, from sources at his very gates, with the most necessary ingredients for the cultivation of his crops. As these sources all lie within the province of the Institute, it will be the hope of every member that the home farmer may speedily learn to appreciate benefits that can greatly improve his position, and that can help to bring about that return of prosperity to agriculture so essential to the well being of the nation.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, June 10th, 1897.

The Visit of the Southern Association to Croydon.—Cyanogen Recovery.—The Incandescent Gas Light Company.—The Gas Institute.

One of the events of the month of May is the summer meeting of the Southern Association of Gas Managers, and the attendance at this gathering shows that papers and discussions are not the only attraction. It is the one meeting at which the element of recreation is allowed to take a prominent place, though business is by no means shown into a back seat. This year the attendance was unusually large, not only by reason of the excellence of the programme, but also because of the popularity of the President for this year, who is none other than Mr. J. W. Helps, well known as Honorary Secretary of the Association for several years past. Sometimes the Presidency in District Associations is like the "Chiltern Hundreds" of Parliamentary fame. The Secretary steps into the Presidential chair, and in course of time retires on the other side, and is seen no more in an official sense. Fortunately for the Association this is not to be the case with Mr. Helps.

The members know when they are well off, and have taken care to block up every way out of the Presidential chair except that which leads back again to the secretarial desk. Assembling at the Croydon railway station in the morning, the party found well appointed brakes in readiness, and without loss of time were conveyed to the electric light works, recently erected by the municipal authorities at a cost of £37,500, and capable of supplying 20,000 8 candle power lamps. Here they were joined by the Mayor of Croydon and Mr. Ald. Miller, Chairman of the Electric Lighting Committee. The plant comprises three Davey-Paxman marine type boilers, three Bellis engines, three Thomson-Houston alternators, each 120 K.W., and working at 2,000 to 2,200 volts, a Thomson-Houston motor alternator, two Ferranti rectifiers, high tension and low tension switchboards, ammeters, voltmeters, etc. One cannot but be struck by the fact that the subtle agent is well under control, and that the operation of generating electricity is not attended with the grime and sweat that are such objectionable features in the case of coal gas. The company were next conveyed to the gas works, where a table of light refreshments was first carefully inspected and several members gave tacit evidence of the fact that they had breakfasted at a very early hour, and then a tour of the works was made under the guidance of Mr. Helps, who has evidently engineered and managed them with the same success that is such a conspicuous feature in connection with his efforts on behalf of the Southern Association. The principal items of interest were a new gasholder in three lifts, 200 feet in diameter and 110 feet high, a Maxim-Clarke carbureting apparatus, an overhead crane and grab for loading coke, and some regenerative furnaces. Another short drive took the party to the "Greyhound" Hotel, where a substantial and elegant luncheon was served, by order of the Directors of the Croydon Gas Light Company. The Chairman, Mr. J. P. Hussey, presided, and after a few complimentary toasts, a visit was paid to the new town hall. The brakes were again in requisition, and after a drive of about 1½ hours' duration through lovely country scenery, the party were set down at the Crystal Palace. A high tea brought a most successful day's outing to a close, the whole arrangements having been ably carried out by Mr. D. H. Helps, the Honorary Secretary, *pro tem.*

An interesting paper on "Cyanogen Recovery" was read and well discussed at the recent meeting of the Institution of Gas Engineers, from which it is evident that cyanogen can be as easily removed from coal gas as ammonia, and recovered either as a ferrocyanide, sodium potassium or iron, as may be desired, at a cost of something like 1½d. per pound of crude ferrocyanide. But with the experiences in the matter of sulphate of ammonia in view, gas engineers are not so easily captivated with the prospect of a new residual as they used to be. The supervision and maintenance in working order of a sulphate plant, buying acid and selling the product represent a considerable addition to a gas engineer's duties and responsibilities, and it is an addition that more often than otherwise has never received proper recognition from the directorate. But so long as it returned a clear profit of about 1s. 6d.

per ton of coal carbonized, the gas manager felt that there was something to show for his labors. When, however, the profit dwindles to a mere trifle, he begins to feel that outsiders are getting the benefit of his labors. At present rates there are many gas works in the country where sulphate is being made at a loss. If situated at a distance from a well-known seaport, or from the nearest railway station, the cost of freightage is great, as it applies not only to the manufactured salt but also to the oil of vitriol. Thus if the sulphate has to be carted two miles and trained 100, the chances are that the acid has to be conveyed a similar distance, the oil of vitriol works being invariably situated near the seaboard. Under such circumstances the cost for acid alone may mount up to one-half of the total receipts, leaving labor, wear and tear, fuel, lime, packing, bags, carriage, etc., to come from the residue. Under the best circumstances, as shown by the statistics of the principal London and provincial undertakings published in *Field's Analysis*, 1896, the profit from sulphate is only 1d. to 1¼d. per 1,000 cubic feet of gas sold on the average, some few getting as much as 1½d., and others as little as ½d., according to situation, which is sufficient to show what the state of affairs must be in out-of-the-way country towns. No wonder, then, that the prospect of 2 to 5 pounds of ferrocyanide per ton of coal is not an attractive bait, and that the "once bit, twice shy" gas engineer hangs back and wants to know where the profit comes in and what the selling prospects of ferrocyanide are likely to be.

The report of the Incandescent Gas Light Company for the year ended March 31st last, has been issued to the shareholders and indicates a very prosperous state of affairs. The number of burners sold during the year is close upon 1,000,000, showing an increase of over 50 per cent. on the previous year, from which it appears that the reduction in prices made at the commencement of 1896 has been duly appreciated by the public. It would be interesting to know how many mantles, exclusive of those supplied with new lamps, have been sold by the Company. But the report doesn't state this. The total income for the year amounts to £440,000 in round figures, of which, notwithstanding the reduction just mentioned, about one-third is net profit, enabling the payment of large dividends, and substantial additions to the reserve and to the depreciation funds. One million additional incandescent burners means a large consumption of gas. Each burner at a fair average will consume 3,000 to 4,000 cubic feet per annum. So it is evident that the incandescent department of our business has acquired an extent that is not to be despised. Of course we do not overlook the fact that, perhaps in the majority of cases, the incandescent simply displaces a flat flame burner, but in many instances it replaces the oil lamp or the electric light. The fact that gas consumers are becoming sufficiently educated to their own interests to be willing to adopt a sensitive appliance that must be used with care and intelligence is very encouraging as regards the future. For the chief hindrance to extended use of gas has been the ignorance and prejudice of the users The careful usage entailed by the Welsbach burner will in time extend to cookers, heaters and engines. People will appreciate the fact that it pays to keep things clean and in good order. And here I may observe that before these notes reach you, the Birmingham medal of the Gas Institute will have been bestowed upon Dr. Auer von Welsbach, who is a most worthy recipient for any honor or compliment that the gas fraternity can offer. It is not too much to say that his invention has marked a new epoch in the history of gas lighting.

The annual meeting of the Gas Institute is a week later than usual, on account of Whitsuntide, and occupies a most unfortunate position in being sandwiched between that public holiday and the National Jubilee rejoicings that are to commence on the 21st inst. Consequently many members will be unable to leave home to attend the meeting. The monthly board meeting will be either pushed backward a week on account of the Jubilee, or forward to a corresponding extent because of the Whitsun holidays. Provision must be made for dealing with the illuminations that will be largely in demand and for providing the gas that will be required by them. Apart from ordinary business many will be called upon to take part in arranging the public festivities which will be held on a liberal scale in every town. So it is to be feared that the success of the 1897 Gas Institute meeting will be prejudiced or overshadowed to some extent. The President—Mr. C. Stafford Ellery, of Bath—and Council have issued a carefully arranged Agenda including nine papers, a lecture by Prof. Lewes and the usual inaugural address. The meeting is to be held at Bath, and will be opened by a few words of welcome from the Mayor of that historic town, who will also give an evening reception. A smoking concert and a day's excursion are among the recreative elements, besides which the neighborhood abounds in features of interest to the student of history and antiquities. The membership at the end of 1896 included 634 names. There have been 23 removals by death and other causes during the year, whilst the new ballot list contains no less than 52 names. Amongst the deceases is the name of Mr. Thomas Travers, of Cork, a regular contributor to the proceedings during the last 25 years, Mr. John McCrae, of Dundee, and Mr. David Clarke, of Ashton-under-Lyne, all of whom were regular attendants at the meetings and will be regretted by a wide circle of friends. The library has not been overlooked during the year, and another satisfactory feature is that about 40 gas undertakings have subscribed to the funds during the year, their contributions amounting to £85. The money will be useful, but the support and sympathy indicated by these attentions are very acceptable on their own account. The arguments as to the desirability of some support to gas engineers' associations being received from shareholders and directors of gas undertakings do not need repetition here; but however patent they may be to gas engineers and managers, it is very difficult to get them properly appreciated on the other side of the counter.

Gas is enjoying a wonderful period of peace and prosperity at present, but with the restless energy that is being applied in other directions, it would be well to give some attention to the strengthening of its position, so as to be better able to meet the trials that are sure to come in one form or another. There are numerous questions awaiting solution that can only be adequately dealt with at considerable cost, and which have a fair claim on all interested in the sale of gas, and not on managers alone. So it is to be hoped that the companies' subscription list will continue to increase. The general statement of accounts is very satisfactory. It shows £72 carried to the accumulated fund which now stands at over £1,000, exclusive of nearly £2,000 belonging to the benevolent fund.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

It is said that Messrs. F. F. Lamb, F. R. Plance, J. H. Galvin, H. W. Drew and L. Bradenburg have formed the Metropolitan, Light, Heat and Power Company, to supply gas for light, heat and power purposes in Parsons, Kansas. The Parsons Light and Heat Company has been supplying gas in the place named for several years.

Treasurer Slater has notified the shareholders of the Providence (R. I.) Gas Company that a dividend of $1 per share is payable on the 1st of July.

A semi-annual dividend of $3.50 per share has been declared by the New Orleans Gas Light Company. It is payable on and after July 15th.

President House and General Manager McKeever, of the Houston (Texas) Gas Light Company, have informed the residents of that city that the following selling rates are to rule until further notice: For gas used for lighting, $2 per 1,000 cubic feet; for fuel and power use, $1.75 per 1,000 cubic feet. The Company has determined to largely increase its sendout on fuel account, and with that end in view has purchased a large line of the latest styles of gas cookers, gas heaters, hot plates, instantaneous water heaters, etc., which are kept on show in its main office. The appliances will be placed in the premises of consumers on the most liberal terms possible.

Writing of the gas rate reduction in Houston brings to mind the fact that the special committee of the Houston City Council (Alds. Geiselman and Cronan), appointed to consider the question of the status of the Houston Gas Light Company in the relation of the latter to the city authorities, submitted the following ordinance, which, up to our latest advices (June 17th), had not been definitely disposed of:

Whereas, The franchise hitherto granted to the Houston Gas Light Company, on February 14th, 1867, for the purpose of maintaining a pipage system for supplying consumers with gas has expired; and

Whereas, The Houston Gas Light Company now has no right to the use and occupancy of the streets of Houston for maintaining such pipage system and gas plant; and

Whereas, Said Houston Gas Light Company has refused to comply with the conditions and stipulations required by the city of Houston for the renewal of its franchise; therefore be it

Ordained by the City Council, That the ordinance passed on May 17, 1897, the provisions of which not having been accepted by the Houston Gas Light Company, and any other ordinances granted the Gas Company, affecting the use and occupancy of the streets, for maintaining a gas and pipage system for supplying consumers with gas be, and the same are hereby repealed.

Sec. 2. That the Street Commissioner is hereby instructed to at once

remove the pipes of the said Houston Gas Light Company from the streets of the city.

ALL of which looks very drastic. Meanwhile President House and his associates in the Houston Gas Light Company are not evincing decided symptoms of uneasiness over this proposed action of the City Council; for they very well know that confiscation of property is not rulable under the laws of Texas.

MR. JOHN L. WILLIAMS, a Director in the Buffalo (N. Y.) Gas Light Company, died at his home, No. 279 North street, Buffalo, on the morning of the 16th inst. A correspondent forwards the following brief note respecting the career of deceased: "Born in Buffalo, July 9th, 1838, Mr. Williams' entire life was spent in that city where he was identified with many of its prominent banking, commercial and social interests. Besides his Directorship in the Buffalo Gas Light Company Mr. Williams served the Buffalo Loan and Trust Company and the Buffalo Railway Company in a similar capacity. Mr. Williams is survived by his widow and two sons."

IT is reported that Peter D. English is endeavoring to secure a franchise for the operation of a fuel gas plant for South Bend, Ind. The bait that he holds out is the promise that a rate not in excess of 75 cents per 1,000 cubic feet shall be charged.

THE East Chester Gas Company, of Mount Vernon, N. Y., is now located in its handsome new office building at Prospect and North Third avenues. A local paper in announcing the removal says: "The building meets very fully the needs for which it is intended."

AT the annual meeting of the Raleigh (N. C.) Gas Company the following officers were elected: Directors, B. P. Williamson, H. W. Jackson, John R. Ferrall, W. B. Grimes, C. M. Hawkins, M. J. Hawkins, B. S. Jerman, A. M. Powell, G. Rosenthal; President, B. P. Williamson; Vice-President, H.W. Jackson; Secretary and Treasurer, W. T. McGee.

THE Oakland (Cal.) Gas Light and Heat Company is extending its mains to the outlying district of South Berkley.

A CORRESPONDENT forwards the following, under date of the 19th inst.: "At a meeting of the Board of Aldermen of Chicopee, Mass., held last week, the principal business transacted was the examination and discussion of the petition of the Chicopee Gas Light Company for a franchise. The citizens were also invited to take part in the hearing. Ald. Luther White opened the hearing by reading the conditions of the franchise asked for by the Company, which franchise had been approved by the Legislature. Ald. White said that the Chicopee Gas Company, which had been supplying the city of Chicopee with gas and had a capital stock of $40,000, was ready and willing to sell its interest to the Chicopee Gas Light Company for $60,000, which the latter was willing to pay. The Chicopee Gas Light Company has been regularly organized under a certificate granted by the Legislature. Only one remonstrant was present, Mr. T. O'Connor, of Chicopee Falls. He claimed that the franchise should only be granted on conditions that the city have the right to purchase the property, at the end of 5 or 10 years, as was thought best. After the single remonstrant was heard, the Board took a recess, which time was taken up in a session in the Mayor's office, the City Solicitor sharing therein. On reassembling a vote was taken on the petition, and it was unanimously voted to accept the same. The capitalization of the Chicopee Gas Light Company is $100,000, and it may also issue bonds in the sum of $75,000."

THE following is the official announcement by the proprietors of the Chuctanunda Gas Light Company, of Amsterdam, N. Y., respecting a reduction in the selling rates:

"AMSTERDAM, N.Y., June 19, 1897.

"At a meeting of the Directors of the Chuctanunda Gas Light Company, held last evening, it was decided to make extensive improvements to our plant. We propose to improve the works to the highest degree of economy in the manufacture of gas. When such improvements are made, we believe we shall be able to sell gas for less money, and in anticipation of such results, we passed the following resolution:

"*Resolved*, That the price of gas be made $1.25 per 1,000 cubic feet, commencing July 1, 1897.—STEPHEN SANFORD, President."

THE daily newspapers report that "9 tons weight in coppers are taken every week from the London penny-in-the-slot gas meters. It is proposed to supply electricity on the same plan."

THE Syracuse (N. Y.) Gas Company has completed a very successful series of public demonstrations of the value and utility of gas as a cooking agent. The main illustration was in the Company's office in the "Durston" building, "afternoon teas" and luncheons of the most appetizing order being there served in a flawlessly artistic manner. Mrs. A. E. Marsh, Secretary of the Bureau of Information of the Household Economic Association, of Syracuse, Miss Stella Downing and Miss Ida Henn were the illustrators of the use of gas as fuel, and the demonstrations lasted from 11 A.M. to 5 P.M. The lecture room was beautifully decorated with potted ferns, shrubs and flowering plants, and the visitors and participants included representatives of the best social life of Syracuse. About 2,000 families of that city now use gas for cooking purposes, and the Company so far this season has placed 600 ranges.

THE proprietors of the Perth Amboy (N. J.) Gas Light Company have awarded a contract for the construction of a new holder to Messrs. Riter & Conley, of Pittsburgh, Pa. The vessel is to have a capacity of 40,000 cubic feet, and the cups, etc., are so arranged that a second section can be added when the occasion for the increase comes to hand. The Company will also make considerable main extensions. Superintendent Ross is quite elated over the increase in sendout that is of daily (and nightly) occurrence.

THE Auburn (N.Y.) *Bulletin*, in noting the last action in the case of Carl Armbruster, respondent, vs. the Auburn Gas Light Company, appellant, says: "Judgment and order reversed and a new trial ordered, with costs to abide the event unless the plaintiff stipulates to reduce the damages to $1,500, in which case judgment and order affirmed, without costs of appeal to either party. This was an action brought for the recovery of damages for the destruction of certain plants in the greenhouse of the plaintiff by escaping gas from the mains of defendant, and also for injury to the health of the plaintiff's family. Judgment was recovered by the plaintiff on trial for $2,000."

ARTICLES incorporating the Flushing (L. I.) Gas and Electric Light Company have been filed. The capital stock is put at $300,000, and the Directors for the first year are Messrs. Charles Whitehead, Fred. J. Witt and B. F. de Freece. This concern is evidently intended to complete the consolidation of hitherto independent lighting companies in Queens county, L. I.

THE proprietors of the Doylestown (Pa.) Gas Company have decided to reduce the selling rate of gas supplied on fuel account during the months of June, July, August and September, to $1 75 per 1,000 cubic feet.

NO gas engine works will be constructed at Benton Harbor, Mich., the residents having failed to raise the $50,000 demanded by the promoters of the Company. In fact, the subscriptions pledged amounted to only $8,000.

THE regular quarterly dividend of 2½ per cent. on the shares of the Cincinnati Gas Light and Coke Company is payable on the 1st prox.

AT the annual meeting of the Gas Light Company of the City of New Brunswick, N. J., the following officers were elected: Directors, J. Bayard Kirkpatrick, Lafferd Totten, S. V. D. Clark, John H. Van Duersen and Loyal T. Ives; President, J. Bayard Kirkpatrick; Treasurer, Lafferd Totten; Superintendent, Samuel C. Gowen. This election was looked forward to with much interest, as it was known that some of the shareholders, who are also interested in the local electric lighting concern, would attempt to secure representation on the Board with a view to furthering a project for the amalgamation of the interests of the Gas and Electric Light Companies. The result shows that the old gas interests are to all intent and purpose practically intact.

AT a meeting of the Lighting Committee of the Camden (N. J.) City Council, held the evening of last Tuesday, it was determined to award the contract for the public lighting by means of gas, on the following basis: Ordinary open flame burners, $20 each per annum; lamps equipped with single Welsbach burners, $24 each per annum; lamps equipped with double Welsbach burners, $28 each per annum. The lighting table is virtually on an all night and an every night basis.

THE Board of Public Works, of St. Paul, Minn., in reporting to the Council on the public lighting of the city for the past half year, says

(*Continued on page* 1047.)

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PROPRIETORS.

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CHAS. E. SANDERSON,
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MONDAY, JUNE 28, 1897.

(*Continued from page* 1046.)

that 2,682 gas lamps, 3,154 gasoline lamps and 114 arc lamps were maintained during the period noted.

THE proprietors of the Ipswich (Mass.) Gas Light Company, it is said, have determined to change their oil gas plant over to a water gas system of the Kendall type, which decision prompts the query, "Is this a change for the better?"

AT the annual meeting of the Trenton (N. J.) Gas Light Company the following officers were chosen: Directors, Lewis Parker, Edward H. Stokes, Clark Fisher, John S. Chambers and Charles E. Green; President, Lewis Parker; Treasurer, John S. Chambers; Secretary, Thos. S. Chambers.

THE Directors of the Pawtucket (R. I.) Gas Company have perfected the following executive organization: President, Lyman M. Darling; Treasurer, Charles L. Wright; Secretary, Edwin A. Perkins; Superintendent, Wm. McGregor.

A MAN named Almon G. Danforth is the figurehead in an application for a franchise to operate an opposition gas and electric light plant in Peoria, Ills.

AN attempt is being made to resuscitate the opposition scheme (labeled the Provident Gas Company) in gas supply for Springfield, Ills. The "directing executive" in this instance bears the name of Capt. P. W. Harts.

GAS INSPECTOR MEEDS, of Minneapolis, Minn., favors the use of the Welsbach lamp and burner for the illumination (in great part, at least) of the streets of that city.

Acetylene Gas in Philadelphia.

The Philadelphia Fire Underwriters' Association has decided to grant permission for the use of acetylene gas in liquefied form under pressure for lighting purposes, provided that the pressure of gas on the piping in the building to be assured shall at no time exceed one-quarter pound per square inch, and that the cylinder containing the liquefied gas under pressure and all pressure reducing and safety devices be located outside of such building, and in a separate building well ventilated to the outer air, but of sufficient strength to protect the apparatus from outside interference and from the weather (especially the sun's rays); and that the supply pipe for the building be provided with a hand valve just inside of the building assured, so that the gas may be entirely shut off from such building. It is also provided that the cylinder containing the liquefied gas under pressure shall be equipped with a safety valve to protect against both excessive pressure and unusual increase of temperature, and that both the pressure reducing and the safety (mercury) valves shall be provided with vent pipes opening into the outer air; and that no acetylene gas or calcium carbide shall be stored on the premises.

Moving a Tall Brick Chimney.

Messrs. W. H. & C. P. Topping, of Bridgehampton, N. Y., writing to the *Engineering Record* respecting a contract recently carried out by them, say that a difficult feat was recently accomplished at Manchester, N. Y., in the moving of a brick chimney nearly 1,000 feet without injury. The chimney is 85 feet high, with double 8 inch brick walls 3 or 4 inches apart and nominally bonded together by three or four bricks on each side every 8 or 10 feet in height. The chimney is 7 feet square outside at the base, tapers slightly, and is estimated to weigh about 200,000 pounds. Holes were cut through the lower part of the chimney from side to side and through them large square horizontal timbers were inserted to project 8 or 10 feet on each side. On top of these timbers other large horizontal timbers of the same length were laid at right angles to the first, one on each side of the chimney, close to the wall. A double rectangular cross platform was thus formed, the end of the pairs of beams were connected by cross timbers, and from each of these a pair of inclined braces were put up and secured to a timber collar encircling the chimney about 12 or 14 feet above the bottom timbers.

This framework constituted a cradle that practically extended the base of the chimney to a diameter of over 20 feet. Crossbeams were placed under the lower sills of the cradle and supported on timber shoes, which were planed on the bottom and greased to slide on skids 50 feet long, from which the whole weight of the chimney was supported after the remaining lower brickwork had been cut away. The skids were supported on ordinary timber crib blocking, as much as 5½ feet high in some places where the ground was very rough. Grades of 3½ feet ascending and 5 feet (per 100) descending were encountered and safely overcome. The chimney was moved by a single horse working a 30 gear capstan that operated a 5-part (⅞ inch) chain tackle. The chimney was revolved 90° about its vertical axis and was loaded, moved and set on its new foundation in 9 days by 6 men.

The Market for Gas Securities.

Realizing sales and a line of short stock put out by a certain speculatively bent firm of city brokers caused a break in Consolidated to something under 164. The undertone, however, was sufficiently in line with strength to carry the stock up again to 165½, at which figure it stood at noon to-day—Friday. Other city gas shares were weaker, but there is no good reason for the decline. In fact, at market rates, there is good profit in any of them.

Brooklyn Union is very strong, at 109 bid, and holders thereof are confident that it will go higher. Bay State sold up to 15½ during the week, and Chicago crossed 92 this morning. Baltimore Consolidated also retained the higher value made in it a week or so ago. The United Gas Improvement Company has declared a quarterly dividend of 2 per cent., payable July 15th. The general situation looks decidedly favorable to investors, and our sendout reports all show gains for the current quarter as against the corresponding quarter of 1896.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

JUNE 28.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	164¼	164½
Central	500,000	50	195	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	222½	223
Bonds, 6's	1,000,000	1,000	105	.
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	698,000	..	108	112
Mutual	3,500,000	100	250	255
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	85	
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	73	74
Preferred	2,000,000	100	103½	110½
Bonds 1st 5's	3,500,000	1,000	114	115
" 1st Con. 5's	1,500,000	.	107½	108½
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	111	113
Preferred	5,000,000	100	115	119
Bonds, 1st Mortgage, 5's	1,500,000	1,000	113	116
Yonkers	298,650	50	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	109	..
" " Bonds (5's)	15 000,000	1,000	112	..
Bay State	15,000,000	50	15½	..
" Income Bonds	2,000,000	1,000	..	35
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	87	.
2d " " "	3,000,000	1,000	61	..
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	91¼	91¾
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	104	104¼
Columbus	1,000,000	..	77½	78x
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	75	80
" Bonds	600,000	1,000	101	103
Cincinnati G. & C. Co.	8,500,000	100	201½	202
Consumers, Toronto	1,800,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	56	57
Mortgage, 6's	3,000,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	22	..
" Con. Bonds	4,312,000	..	73½	74
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	81	88
" Bonds	2,000,000	..	89	92

Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	145	148
" Bonds, 6's	2,650,000	..	104	106
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind	1,000,000	100	84	88
Bonds	1,000,000	1,000	92	95
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	2¾	14
Preferred	2,500,000	100	80	81
Bonds	9,034,400	1,000	93½	100
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	98	98
Bonds, 6's	4,000,000	..	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	53½	54
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	94	94¼
St. Paul Gas Light Co.	1,500,000	100	79	81
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	70½	71
Bonds, 5's	3,556,000	.	95½	96
Wilmington, Del.	500,000	50	200	202

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., 1
813 DREXEL BUILDING, PHILA., June 24, 1897. }

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable on July 15, 1897, to stockholders of record at the close of business June 30th. Checks will be mailed.

1151-3 EDWARD C. LEE, Treasurer.

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By a good, settled young man, as Bookkeeper, Collector, or to deliver bills and do Office work for a Gas Company. Best of references. Address

H. A. REW, Box 876,
1151-1 Wellington, Kansas.

Position Wanted

As Superintendent of Coal Gas Works,

by an all-round man. Is master of all details in the manufacturing and distributing departments. Best of references. Address

1148-2 "F. W.," care this Journal.

Position Desired

As Superintendent of Gas Works or Gas and Electric Light Works,

By a man 34 years of age. Sixteen years' experience in the manufacture and distribution of Coal Gas as Supt., and four years in the Electric line. Thoroughly competent to take charge of any plant, separately or combined. A practical mechanic, and understands the erection of gas plants and everything pertaining to the business. Not afraid of work. Salary no object until ability is proven. Best of references.

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Wanted, Second-Hand Tanks Suitable for Holding Heavy Oil.

To be of capacity from 5,000 to 800,000 gallons. Please quote price on above separated into sections suitable to load on cars. Address, with full particulars,

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An 8-Foot Station Meter,

Second-hand, but in good condition. Address

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For Sale.

A Small Gas and Electric Light Plant,

in a Southern city of 3,800 inhabitants.

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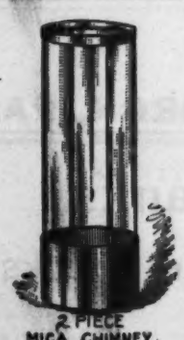

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Micasmiths,
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FOR SALE.

Hydraulic, Dip, Branch and Ascension Pipes, Mouthpieces and Lids, for four Benches of 5's and for one Bench of 3 retorts.

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D-Shaped Tar Extractor, 8 ft. long, 1 ft. 6 in. deep.

Scrubber, 48 in. diameter, 11 ft. 9 in. high. Three man holes, 11 in. by 15 in.

8-inch Center Seal. Four Purifiers, 8 ft. x 6 ft.

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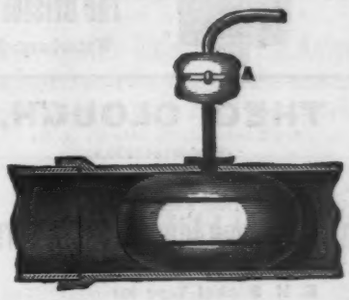

These Gas Bags are used to stop the flow of gas while repairing or making alterations in gas mains. There have been numerous cases of workmen being badly injured, and sometimes fatally, by the escape of gas resulting from the bursting of a bag, and our patent improvement is designed to obviate such calamities. The indicator *A* shows unerringly when the bag has been sufficiently inflated to pack the main, and when the pumping should be stopped. Our Bags are made of a rubber stock especially prepared to admit of great distension, and to resist the action of Oils, Gases, Naphtha and other residuum in the mains, and they are made with lapped joints, which adds greatly to their strength.

3-in. Gas Bag, each,	$0.60		12-in. Gas Bag, each,	$5.00	
4 " " "	.80		16 " " "	8.25	
5 " " "	1.05		20 " " "	12.00	
6 " " "	1.75		24 " " "	17.00	
8 " " "	2.65		30 " " "	27.50	
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We also make the Cheapest and Strongest REVERSIBLE BOLTED TRAYS IN THE MARKET.

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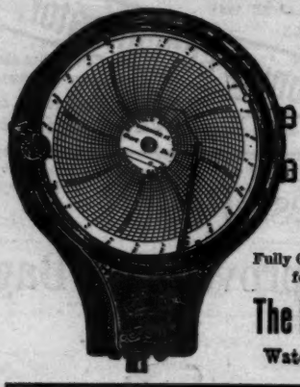

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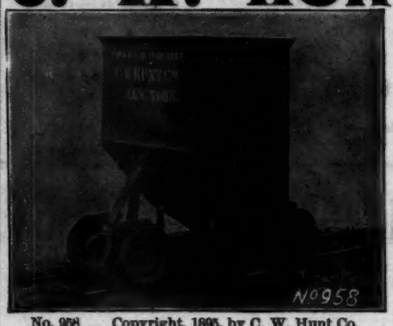

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GASHOLDERS, with or without Steel Tanks.

Purifiers, Condensers, Scrubbers, Oil Tanks, Smoke Stacks.

STEEL ROOFS and BUILDINGS.

PLATE AND STRUCTURAL WORK OF EVERY DESCRIPTION.

THE Patent "Standard" Washer-Scrubber

(U. S. A. Patent, No. 486,927 of November 29, 1892.)

As in use in most of the principal Gas Works in Great Britain and on the Continent of Europe.

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From MR. W. R. CHESTER, Engineer to the Nottingham Corporation.

"The Washer fitted at Basford last year with your new Patent Wood Segments, works well, and I am quite satisfied with it. I propose to have each vessel converted to wood segments, as the iron ones wear out."

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Will cut from 2 in. to 24 in.
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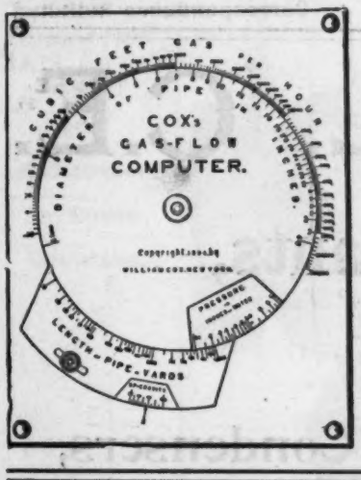
Stettin "Anchor" & "Eagle" Brand Portland Cement
10 & 12 Old Slip, New York.



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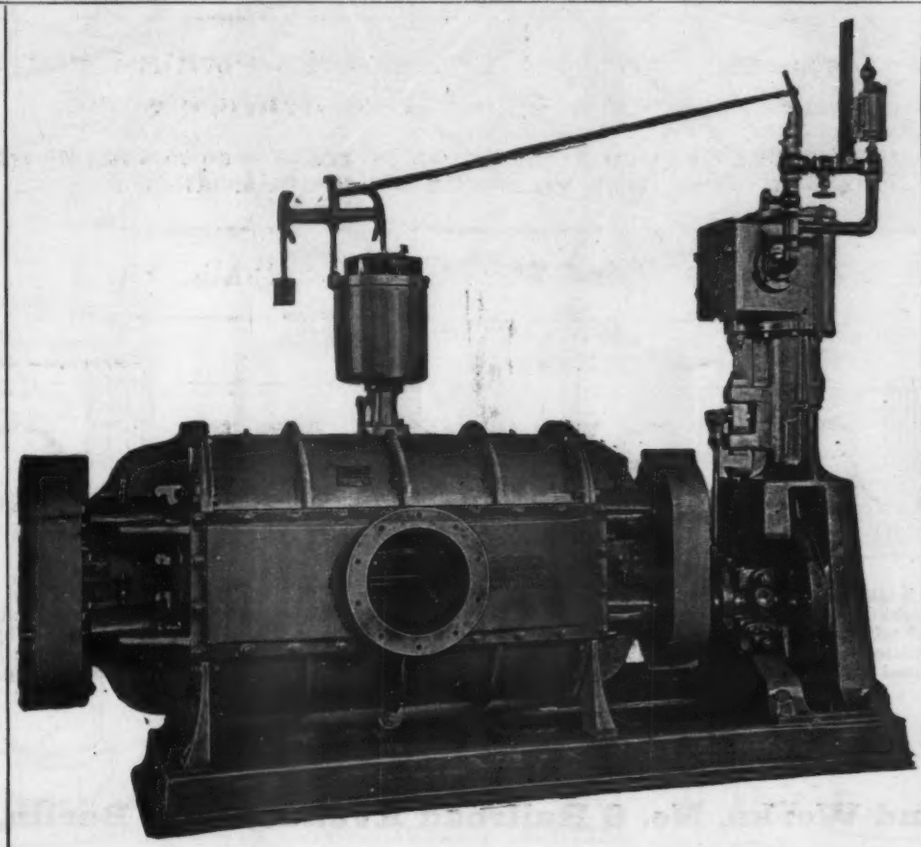

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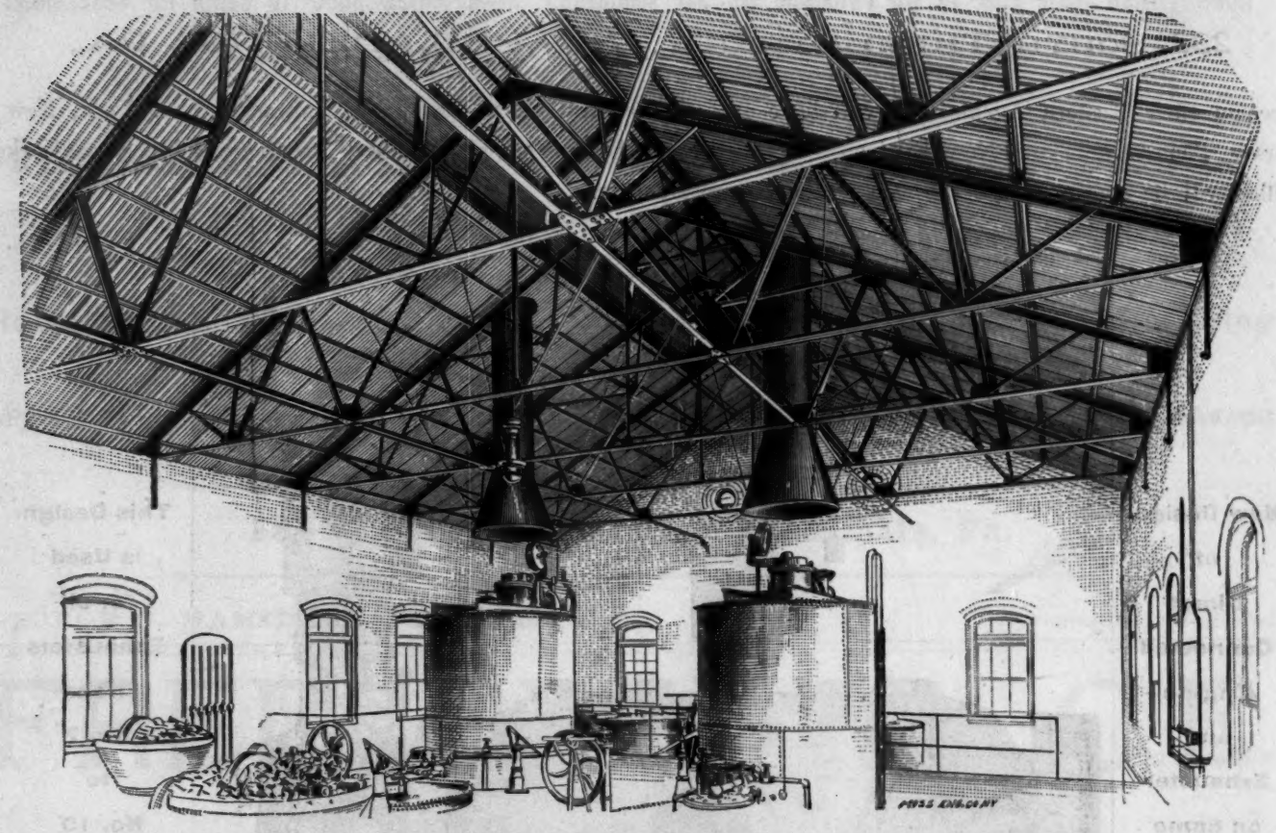

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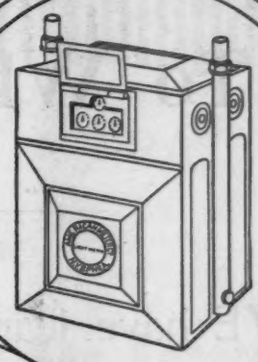
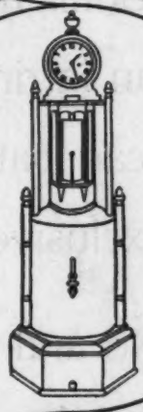
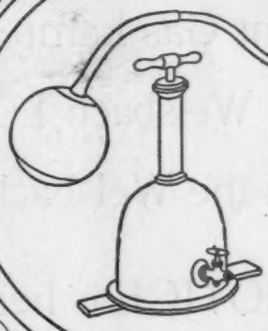


PUBLIC LIGHTING TABLE.

JULY, 1897.

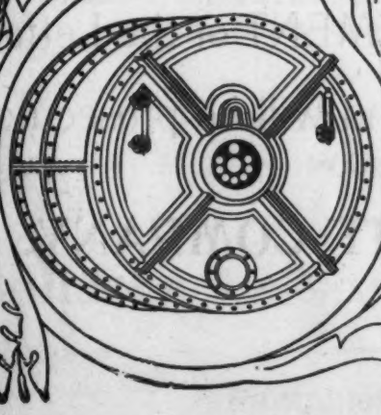
Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M	A M.
Thu.	1	8.00 PM	3.30 AM	7.30	3.15
Fri.	2	8.00	3.30	7.30	3.15
Sat.	3	8.00	3.30	7.30	3.15
Sun.	4	9.10	3.40	7.30	3.15
Mon.	5	9.40	3.40	7.30	3.15
Tue.	6	10.00	3.40	7.30	3.15
Wed.	7	10.30 FQ	3.40	7.30	3.15
Thu.	8	11.00	3.40	7.30	3.15
Fri.	9	11.40	3.40	7.30	3.15
Sat.	10	12.30 AM	3.40	7.30	3.15
Sun.	11	1.30	3.40	7.30	3.15
Mon.	12	No L.	No L.	7.30	3.15
Tue.	13	No L. FM	No L.	7.30	3.15
Wed.	14	No L.	No L.	7.30	3.15
Thu.	15	8.00 PM	9.30 PM	7.30	3.15
Fri.	16	8.00	10.00	7.20	3.15
Sat.	17	8.00	10.30	7.20	3.15
Sun.	18	7.50	10.50	7.20	3.15
Mon.	19	7.50	11.10	7.20	3.15
Tue.	20	7.50	11.30	7.20	3.15
Wed.	21	7.50 LQ	12.00 AM	7.20	3.15
Thu.	22	7.50	12.30	7.20	3.15
Fri.	23	7.50	1.00	7.20	3.15
Sat.	24	7.50	1.50	7.20	3.15
Sun.	25	7.50	2.40	7.20	3.15
Mon.	26	7.50	4 00	7.20	3.15
Tue.	27	7.50	4 00	7.20	3.15
Wed.	28	7.50	4.00	7.20	3.15
Thu.	29	7.50 NM	4.00	7.20	3.15
Fri.	30	7.50	4.00	7.10	3.30
Sat.	31	7.50	4.00	7.10	3 30





TOTAL HOURS LIGHTING DURING 1897.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	233.00	January	423.20
February	187.20	February	355 25
March	202.00	March	355.35
April	170.40	April	298.50
May	163.00	May	264.50
June	140.40	June	234.25
July	151.40	July	243.45
August	167.30	August	280.25
September	174.40	September	321.15
October	200.00	October	374 30
November	205.20	November	401.40
December	220.10	December	433.45
Total, yr.	2216.00	Total, yr.	3987.45



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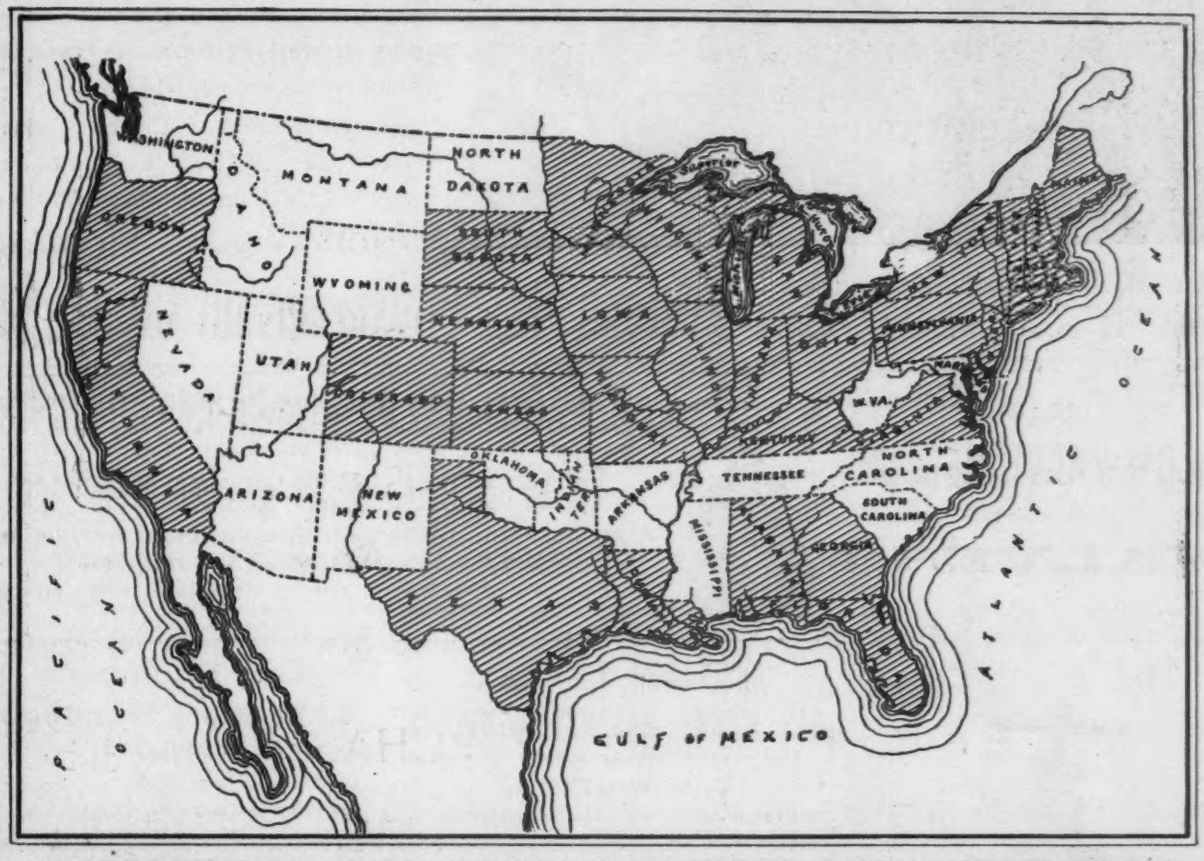

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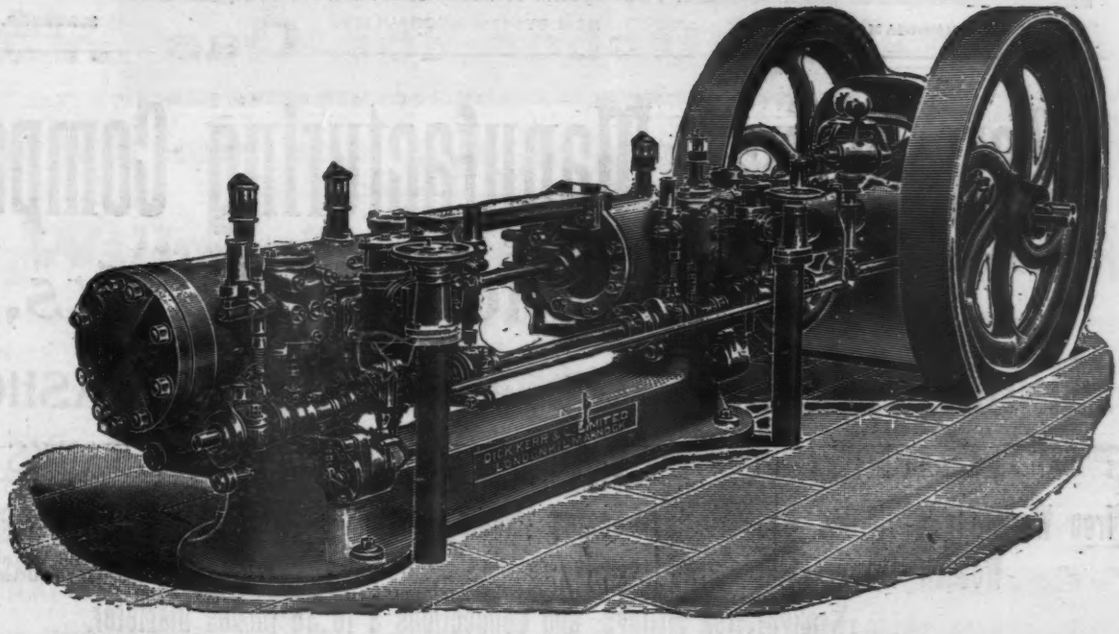

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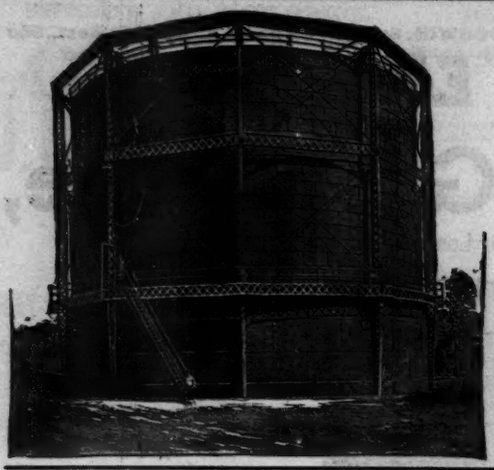

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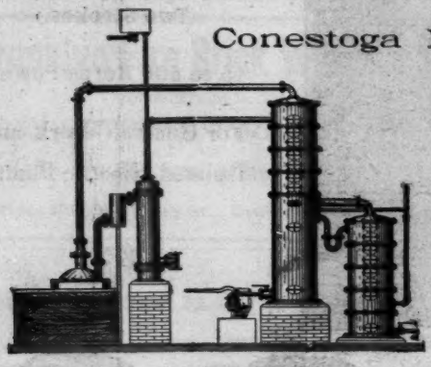

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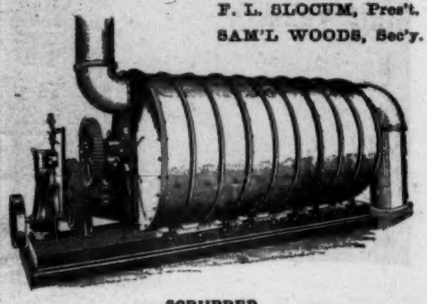

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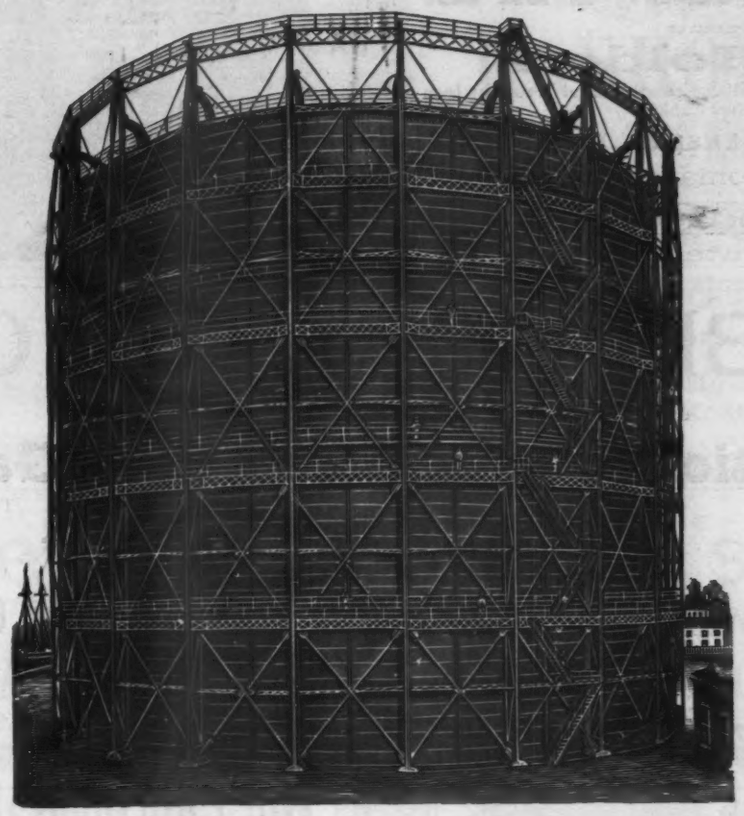

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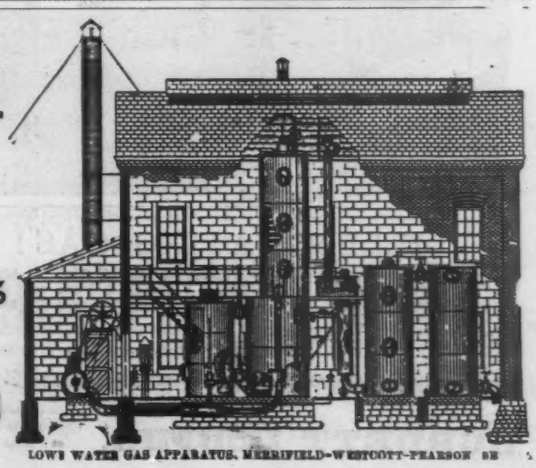

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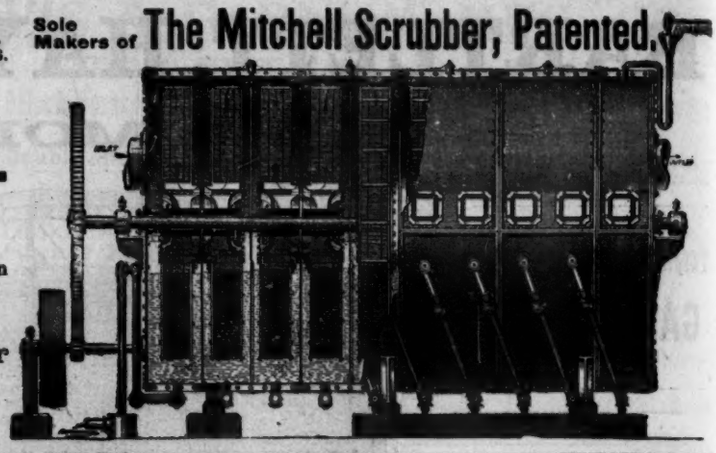

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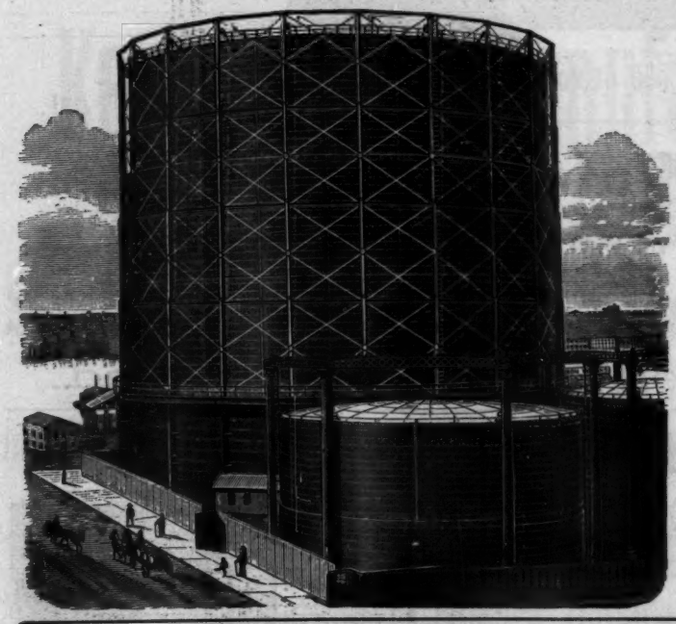

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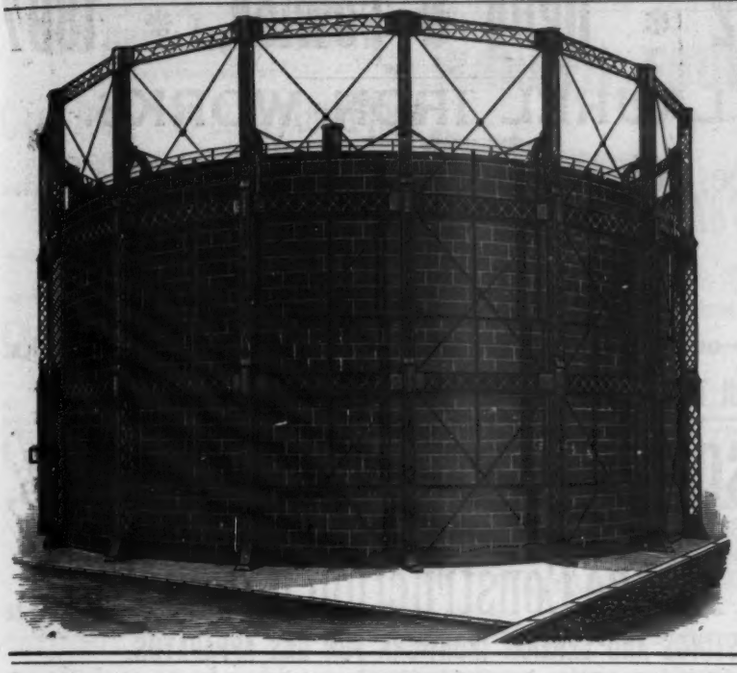

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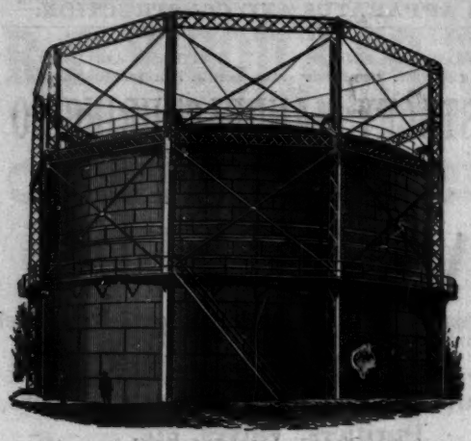

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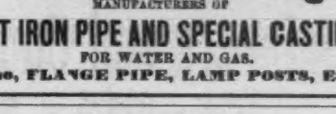

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This Meter is an unqualified success in Great Britain. Its simplicity of construction, and the positive character of the service performed by it, have given it pre-eminence.

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